

**PYRIDIDIUM MERCURY II SITE**  
**ADMINISTRATIVE RECORD FILE**

185634



**INDEX OF DOCUMENTS**

The index of documents contains the following information about each document:

**Document #:** Site Code-Section, First Page-Section 2 - Last Page  
EXAMPLE (ABC 1.1001 - 1.1002)

**Title:** Abstract of Document Contents

**Category:** Document Category/Section of Administrative Record File

**Author:** Writer and Affiliation

**Recipient:** Addressee or Public and Affiliation, if applicable

**Date:** When Document was Created or Transmitted

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**PYRIDIUM MERCURY II SITE  
ADMINISTRATIVE RECORD FILE**

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**PYRIDIUM MERCURY II SITE  
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LIST OF DOCUMENTS**

**Document #:** PM2 - 1.1001 - 1.1003

**Title:** Mitigating Potential Exposures

**Category:** Removal Response

**Author:** G. Anders Carlson, Ph.D., State of New York Department of Health

**Recipient:** Ms. Kathleen C. Callahan, Director, Emergency & Remedial Response Division,  
United States Environmental Protection Agency

**Date:** November 30, 1994

**Document #:** PM2 - 1.2001 - 1.2031

**Title:** Request for a Removal Action at the Pyridium Mercury Disposal Site II - Action  
Memorandum

**Category:** Removal Response

**Author:** Irmgard P. Huhn and Dan Harkay, On-Scene Coordinator  
Removal Action Branch, U.S. Environmental Protection Agency

**Recipient:** Jeanne M. Fox, Regional Administrator  
U.S. Environmental Protection Agency

**Date:** September 29, 1995

**Document #:** PM2 - 1.2032 - 1.2047

**Title:** Request for a Removal Action at the Pyridium Mercury Disposal Site II - Action  
Memorandum

**Category:** Removal Response

**Author:** Dan Harkay, On-Scene Coordinator  
Removal Action Branch, U.S. Environmental Protection Agency

**Recipient:** Kathleen C. Callahan, Director, Emergency and Remedial Response Division  
U.S. Environmental Protection Agency

**Date:** February 27, 1996

**Document #:** PM2 - 1.3001 - 1.3013

**Title:** Sampling Report-Pyridium Mercury Disposal Site No. 2

**Category:** Removal Response

**Author:** Eric Wilson, Project Manager, Roy F. Weston, Inc. and Tom O'Neill, QC Review

**Recipient:** Joseph Rotola, On-Scene Coordinator  
Removal Action Branch, U.S. Environmental Protection Agency

**Date:** October 1994



**Document #:** PM2 - 1.3014 - 1.3128  
**Title:** Sampling Report-Extent of Contamination Study, Pyridium Mercury Disposal Site No. 2  
**Category:** Removal Response  
**Author:** Eric Wilson, On-Scene Coordinator  
Removal Action Branch, U.S. Environmental Protection Agency  
**Recipient:** Public/U.S. Environmental Protection Agency  
**Date:** June 1996

**Document #:** PM2 - 1.4001 - 1.4023  
**Title:** Post Excavation Sampling QA/QC Work Plan - Pyridium Mercury Disposal Site No. 2  
**Category:** Removal Response  
**Author:** Randy Komssi, START Project Manager, Roy F. Weston, Inc. and Joseph Price, QC Review  
**Recipient:** Irmee Huhn, On-Scene Coordinator  
Removal Action Branch, U.S. Environmental Protection Agency  
**Date:** December 1, 1995

**Document #:** PM2 - 1.5001 - 1.5008  
**Title:** Sampling Trip Report- Pyridium Mercury Disposal Site No. 2  
**Category:** Removal Response  
**Author:** Randy Komssi, START Project Manager, Roy F. Weston, Inc. and Joseph Price, QC Review  
**Recipient:** Irmee Huhn, On-Scene Coordinator  
Removal Action Branch, U.S. Environmental Protection Agency  
**Date:** April 26, 1996

**Document #:** PM2 - 2.1001 - 2.1009  
**Title:** Community Relations Plan  
**Category:** Public Participation  
**Author:** Region II Superfund Technical Assessment and Response Team  
**Recipient:** General Public  
**Date:** January 1995

**Document #:** PM2 - 2.2001 - 2.2001  
**Title:** Notice of Public Availability  
**Category:** Public Participation  
**Author:** N/A  
**Recipient:** General Public  
**Date:** January 1996



**Document #:** PM2 - 2.3001 - 2.3002  
**Title:** The Times Herald Record - A poison sewn into the soil  
**Category:** Public Participation  
**Author:** Christopher Mele  
**Recipient:** General Public  
**Date:** October 8, 1994

**Document #:** PM2 - 2.3003 - 2.3003  
**Title:** The Times Herald Record - Memory losses alarming  
**Category:** Public Participation  
**Author:** Christopher Mele  
**Recipient:** General Public  
**Date:** October 11, 1994

**Document #:** PM2 - 2.3004 - 2.3005  
**Title:** The Times Herald Record - Harriman soil tests set  
**Category:** Public Participation  
**Author:** Amy Beth Terdiman  
**Recipient:** General Public  
**Date:** October 14, 1994

**Document #:** PM2 - 2.3006 - 2.3006  
**Title:** The Times Herald Record - Love Canal lessons shared  
**Category:** Public Participation  
**Author:** Amy Beth Terdiman  
**Recipient:** General Public  
**Date:** October 19, 1994

**Document #:** PM2 - 2.3007 - 2.3007  
**Title:** The Times Herald Record - Experts expand soil tests  
**Category:** Public Participation  
**Author:** Amy Beth Terdiman  
**Recipient:** General Public  
**Date:** October 25, 1994

**Document #:** PM2 - 2.3008 - 2.3008  
**Title:** The Times Herald Record - New year will bring new start  
**Category:** Public Participation  
**Author:** Amy Beth Terdiman  
**Recipient:** General Public  
**Date:** December 31, 1994



**Document #:** PM2 - 2.3009 - 2.3009

**Title:** The Times Herald Record - Toxic site residents prepare to relocate

**Category:** Public Participation

**Author:** Amy Beth Terdiman

**Recipient:** General Public

**Date:** N/A

**Document #:** PM2 - 2.3010 - 2.3010

**Title:** The Times Herald Record - Mercury deposit remains a mystery

**Category:** Public Participation

**Author:** N/A

**Recipient:** General Public

**Date:** October 12, 1994

**Document #:** PM2 - 2.3011 - 2.3011

**Title:** The Times Herald Record - Village water mercury free, mayor tells residents

**Category:** Public Participation

**Author:** N/A

**Recipient:** General Public

**Date:** October 12, 1994

**Document #:** PM2 - 2.3012 - 2.3012

**Title:** The Times Herald Record - EPA searches for extent of contamination

**Category:** Public Participation

**Author:** Amy Beth Terdiman

**Recipient:** General Public

**Date:** October 13, 1994

**Document #:** PM2 - 3.1001 - 3.1002

**Title:** EPA Regional Guidance Documents

**Category:** Technical Source and Guidance Documents

**Author:** U.S. Environmental Protection Agency

**Recipient:** General Public

**Date:** N/A

**Document #:** PM2 - 4.1001 - 4.1026

**Title:** Health Consultation Pyridium Mercury Disposal Site #2

**Category:** Health Assessments

**Author:** New York State Department of Health Under a Cooperative Agreement with U.S. Department of Health & Human Services, Public Health Service, and Agency for Toxic Substances and Disease Registry

**Recipient:** General Public

**Date:** August 28, 1995



## CERTIFICATION OF DOCUMENTS

### COMPRISING THE ADMINISTRATIVE RECORD

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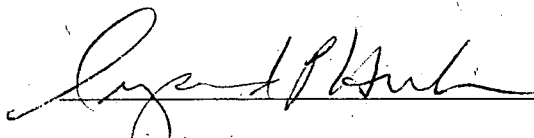
The United States Environmental Protection Agency (USEPA) hereby certifies that the attached documents constitute the Administrative Record for selection of response actions under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, for the **Pyridium Mercury Disposal #1**, located on the village of Harriman Tax Map as Section 103, Block 5, Lot 2, on Route 17M and **Pyridium Mercury Disposal #2** located on the Village of Harriman Tax Map as Section 106, Block 5, Lot 13 in the Town of Harriman, County of Orange, New York, CERCLIS ID # NY0000856237 and #NY0001062850; Spill Id 02EZ and 02EV, respectively.

By the EPA:

In witness whereof I have subscribed my

name this 30th day of March, 2004,

in Edison, New Jersey.



Irmgard P. Huhn, USEPA Region II.





## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY - REGION II

290 BROADWAY

NEW YORK, NEW YORK 10007-1866

ACTION MEMORANDUM

DATE: FEB 27 1996

SUBJECT: Documentation of Verbal Authorization for a Removal Action at the Pyridium Mercury Disposal Site No. 2, Village of Harriman, Orange County, New York

FROM: *James D. Harkay, Jr.*  
James D. Harkay, Jr., On-Scene Coordinator  
Removal Action Branch

TO: Kathleen C. Callahan, Director  
Emergency and Remedial Response Division

THRU: *Richard C. Salkie*  
Richard C. Salkie, Associate Director  
Removal and Emergency Preparedness Programs

Site ID: EZ

**I. PURPOSE**

The purpose of this Action Memorandum is to document the verbal authorization received to conduct a removal action at the Pyridium Mercury Disposal Site No. 2 (Site). The Site is located at 40 South Main Street, Village of Harriman, Orange County, New York, 10926. The Site is a residential property which has been back-filled with mercury-contaminated industrial waste. A two-story house, located on the property, is rented and occupied by a woman and her two children. This document details the rationale used to conduct the removal activities implemented at the Site and discusses how the Site met the criteria for a removal action under Section 300.415(b)(2) of the National Contingency Plan (NCP).

On February 16, 1995, the U.S. Environmental Protection Agency (EPA) Director of Emergency and Remedial Response Division (ERRD) granted verbal authorization to conduct a removal action at the Site to secure and limit access to the mercury contaminated waste disposal area in front of the affected residential house. The funding approval to secure the Site was \$50,000, of which \$30,000 was for mitigation contracting.

The Site is not on the National Priorities List (NPL) and there were no nationally significant precedent-setting issues associated with the removal action.



## II. SITE CONDITIONS AND BACKGROUND

The Comprehensive Environmental Response, Compensation, and Liability Information System ID number for this time-critical removal action is NY0001062850.

### A. Site Description

#### 1. Removal site evaluation

On October 21, 1994, a representative of the New York State Department of Health (NYSDOH) and the Village of Harriman Code Enforcement Officer (CEO) conducted an investigation of the Site. A whitish-grey solid, similar to the waste found at the Pyridium Mercury Disposal Site No. 1 (Pyridium 1), was discovered at the surface where a tree root broke through the soil. The waste was also observed in a residential front yard a few inches below the surface in small holes dug by the resident's pet dog.

On October 26, 1994, at the request of NYSDOH, the EPA and the Technical Assistance Team (TAT) collected three surface soil samples and two waste samples to determine if the Site was contaminated with mercury. Mercury was detected at concentrations ranging from 0.14 mg/kg to 27.5 mg/kg in the surface soils. Mercury was detected at concentrations ranging from 227 mg/kg to 456 mg/kg in the waste samples, collected from depths of 1 to 6 inches below the surface.

On October 29, 1994, nine additional surface soil samples (0 to 3 inches below any vegetative cover) were collected from a fenced portion of the yard which was used as a play area by the children and the pet dog living at the house located on the Site. Mercury was detected in the surface soils at concentrations ranging from 0.16 mg/kg to 117 mg/kg with an average of 35.1 mg/kg.

On November 17, 1994, the EPA Environmental Response Team (ERT) and the Response Engineering and Analytical Contractor (REAC) collected dust samples inside the house at the Site. Mercury was detected at concentrations of 1.38 mg/kg and 2.06 mg/kg in two dust samples collected from inside the house.

On November 30, 1994 the Site was formally referred to the EPA for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) removal action consideration via a letter from NYSDOH (Appendix A) and verbally confirmed by the New York State Department of Environmental Conservation.

On December 7, 1994, ERT, REAC, and TAT collected eleven soil borings on the Site to determine the extent of contamination. Soil samples collected from the borings were screened for mercury using a Spectrace Model 9000 X-Ray Fluorescence Analyzer.



Based on this and previous sampling it is estimated that approximately 500 cubic yards of waste and contaminated soil are present at the Site.

Site residents have been informed of the results of EPA's sampling and have been advised to limit their usage of contaminated areas on the property. A NYSDOH physician has discussed site-specific health concerns with the residents.

## **2. Physical location**

Pyridium 2 is located in a mixed residential/commercial area on South Main Street, near the intersection of Route 17M and South Main Street (Appendix B, Figure 1). The Site is bordered on the northwest by a vacant lot, on the northeast by South Main Street, on the southeast by Ramapo Lane, and on the southwest by a gasoline service station. Two major thoroughfares, New York Routes 17 and 17M, are located less than a half mile from the Site. A grade school and playground are located within a half mile of the Site.

## **3. Site characteristics**

The property encompasses 0.25 acres. The Site includes a nineteenth century farmhouse which predates the waste disposal activities. The two-story farmhouse has a stonewall basement with a concrete floor. The property is owned by Mr. Greg Epsaro of 4 Averill Avenue, P.O. Box 104, Harriman, New York. For the past three years, a woman and her two small children, ages six and seven, have rented and occupied the house.

In the early 1950's, approximately eight to 15 truckloads of waste were allegedly dumped in a "L" shaped configuration across the front yard. The waste was allegedly a mercuric or mercurous salt generated during the production of pyridium by the former Pyridium Corporation. The waste was used to backfill low-laying areas of the front yard.

This is the first removal action undertaken by the EPA at the Site.

## **4. Release or threatened release into the environment of a hazardous substance, or pollutant, or contaminant**

Site investigations indicate that approximately 500 cubic yards of waste are present at the Site. Analytical results of the waste samples indicate elevated concentrations of mercury (max. 456 mg/kg). Mercury is a designated CERCLA hazardous substance as defined by Section 101(14) and is listed in 40 CFR Table 302.4. Mercury is typically found in soils in this geographic location at levels of less than 1 mg/kg.



Sampling conducted by EPA identified elevated concentrations of mercury at and below the ground surface. Mercury contaminated waste and soil present at the surface could migrate off-site by anthropogenic redistribution and surface water runoff and contaminate a larger area.

## **5. NPL status**

The Site is not listed on the NPL. A Preliminary Assessment (PA) may be conducted to determine the need for a Site Inspection (SI) for possible NPL listing. The Site was evaluated by the Agency for Toxic Substances and Disease Registry (ATSDR). The January 1995 draft health consultation is included in Appendix C.

## **6. Maps, pictures and other graphic representations**

Figures 1 and 2 in Appendix B provide the location and configuration of the Site.

## **B. Other Actions to Date**

### **1. Previous actions**

On November 28, 1994, EPA, ATSDR and NYSDOH held a public availability session to address community concerns regarding the potential health effects associated with Pyridium 1 and 2. The analytical results of the soil sampling events were made available to the public during the meeting.

Results of the EPA samples were submitted to ATSDR and NYSDOH for a health consultation. In January 1995, a Draft Health Consultation Report was prepared by the NYSDOH under a cooperative agreement with the ATSDR (Appendix C). The report states that the Pyridium Mercury Disposal Site No. 2 is a public health hazard due to the elevated concentrations of mercury in soils. On-site residents are suspected to be at risk of kidney damage through mercury ingestion, inhalation and dermal contact.

### **2. Current actions**

The purpose of the current action was to secure the Site and minimize the potential for direct contact with mercury contaminated soil and waste. On February 27, 1995, EPA, Emergency Response Cleanup Services (ERCS) contractor and TAT mobilized to the Site to secure and limit access to the waste disposal area.

In order to secure the area, the existing fence was modified to enclose the area of contamination present in the front portion of the property. Additionally, to minimize the potential for continued exposure, a chain-link-fence enclosure was installed in an uncontaminated portion of the rear property to provide a



clean, secure play area for the children and family pet that reside on the Site.

Although mercury concentrations identified in dust samples collected from living areas in the residence were not at levels of public health concern, carpets and vinyl flooring were vacuumed and/or washed as a precautionary measure to remove any residual mercury which may have been tracked into the house by the children's or pet's outdoor activities.

The mitigation contracting cost to complete this removal action was approximately \$12,000.

### **C. State and Local Authorities' Role**

#### **1. State and local actions to date**

In October 1994, the NYSDOH and the Village of Harriman CEO conducted an investigation and discovered the waste at the Site. NYSDOH prepared the Health Consultation in conjunction with ATSDR and participated in public meetings and public availability sessions. A NYSDOH physician consulted with site residents regarding site-specific health concerns.

#### **2. Potential for continued State/local response**

State and local government agencies were unable to undertake timely and costly response actions to eliminate the threats posed by the Site. However, the NYSDOH offered health education services to the affected residents. The NYSDOH will investigate similar sites in the community as they are identified.

### **III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES**

The Site met the criteria for a Removal Action under CERCLA as described in Section 300.415(b)(2) of the NCP. The Site poses a health threat to on-site and local residents and animals that could come in direct contact with the hazardous substances at the Site.

#### **A. Threats to Public Health or Welfare**

Elevated concentrations of mercury, a designated CERCLA hazardous substance, have been documented in surface and subsurface soils. On-site and local residents may have been exposed to mercury through the ingestion of mercury contaminated soil, the consumption of plants grown in contaminated soils, dermal contact with the waste or inhalation of mercury contaminated dust. Toxicological data regarding mercury exposure documents the risk of potential kidney and neurological system damage.



## **B. Threats to the Environment**

High concentrations of hazardous substances located at or near the ground surface have migrated and have contaminated a larger area through surface water runoff and anthropogenic redistribution.

Local animal populations may have come into direct contact with hazardous substances located at or near the surface.

## **IV. ENDANGERMENT DETERMINATION**

Actual or threatened release of a hazardous substance from this Site, if not addressed by implementing the response action selected in this Action Memorandum, would have presented an imminent and substantial endangerment to public health, or welfare, or the environment.

## **V. PROPOSED ACTIONS AND ESTIMATED COSTS**

### **A. Proposed Actions**

#### **1. Proposed action description**

The purpose of this Action Memorandum is to document actions taken by EPA at the Site under the February 16, 1995 verbal authorization of the Director of the ERRD. The removal action minimized the potential for direct contact with the mercury contaminated soil and waste. A chain-link fence was erected to prevent the children from playing in the contaminated area and to provide a clean, secure area for the children and family pet to play. Additionally, the pre-existing fence on the front property was modified to totally enclose the area of contamination. The activities performed under this Action Memorandum cost an estimated \$12,000 for mitigation contracting and were completed on March 9, 1995.

Additional actions are necessary at the Site which may include the excavation and disposal of contaminated soil and the restoration of the Site to pre-excavation conditions. These actions will be undertaken under a separate removal action.

#### **2. Contribution to remedial performance**

The actions presented in this document were consistent with any long term cleanup at the Site and were interim measures necessary to mitigate the immediate threats associated with the hazardous substance on the property.

#### **3. Description of alternative technologies**

No other alternative technologies were considered for securing the Site, since the option chosen was environmentally safe and



cost effective to mitigate the immediate threat to on-site and local residents.

#### 4. Engineering Evaluation/Cost Analysis (EE/CA)

Due to the time-critical nature of this removal action, an EE/CA was not prepared.

#### 5. Applicable or relevant and appropriate requirements (ARARs)

ARARs that were within the scope of this removal action were met to the extent practicable. The federal ARARs determined to be applicable for this removal action was the Occupational Safety and Health Act.

#### 6. Project schedule

The removal actions in this Action Memorandum were initiated on February 27, 1995 under verbal authorization from the Director of the ERRD and completed on March 9, 1995.

#### B. Estimated Costs

A summary of the estimated costs for the completed removal action is presented below.

##### Extramural Costs:

Total Cleanup Contractor Costs (ERCS)	\$12,000
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##### Other Extramural Costs Not Funded from the Regional Allowance:

Total TAT	<u>\$ 4,000</u>
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TOTAL, EXTRAMURAL COSTS	\$16,000
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##### Intramural Costs:

TOTAL, INTRAMURAL COSTS	<u>\$ 2,000</u>
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TOTAL, REMOVAL PROJECT CEILING	\$18,000
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#### VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

The actions outlined in this Action Memorandum were an interim measure to secure the Site and mitigate the immediate threat to on-site and local residents. If no action was taken or the planned action delayed, the on-site residents would continue to be exposed to hazardous substances present at the Site.



**VII. OUTSTANDING POLICY ISSUE**

No known outstanding policy issues were associated with the Site.

**VIII. ENFORCEMENT**

Site-related enforcement activities were initially limited due to time constraints resulting from the time-critical determination for the removal action.

In October 1994, EPA TAT conducted a title and deed search of the property. Property owner information was obtained from 1894 to the present and is being kept on file.

The on-site waste was reportedly generated during the 1940's and 1950's by the Pyridium Corporation. Nepera, Inc., currently owns and operates the facility previously operated by Pyridium Corporation.

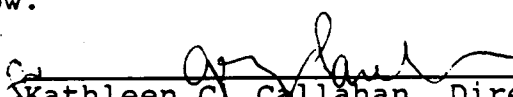
**IX. RECOMMENDATION**

This decision document represents the selected removal action for the Pyridium Mercury Disposal Site No. 2 in the Village of Harriman, Orange County, New York, developed in accordance with CERCLA, as amended, and not inconsistent with the NCP. This decision was based on the administrative record for the Site.

Conditions at the Site met the NCP Section 300.415(b)(2) criteria for the completed removal action. The total estimated project ceiling cost for this phase of the removal action is \$18,000, of which \$12,000 came from the Regional removal allowance.

Please confirm the February 16, 1995 verbal authorization of funding for this Site, as per current Delegation of Authority, by signing below.

**APPROVAL:**

  
Kathleen C. Callahan, Director  
Emergency and Remedial Response Division

**DATE:**

2/27/96

**DISAPPROVAL:**

Kathleen C. Callahan, Director  
Emergency and Remedial Response Division

**DATE:****cc: (after approval is obtained)**

J. Fox, RA  
R. Salkie, ERRD-ADREPP  
W. McCabe, ERRD-DDNYC/P  
G. Zachos, ERRD-RAB  
J. Rotola, ERRD-RAB  
M. Randol, EPD  
E. Schaaf, ORC-NYCSUP  
V. Capon, ORC-NYCSUP

R. Gherardi, OPM-FIN  
S. Murphy, OPM-FAM  
D. Dietrich, 5202G  
T. Eby, 5202G  
C. Moyik, ERRD-PS  
M. O'Toole, NYSDEC  
T. Vickerson, NYSDEC  
C. Kelly, TATL



**APPENDIX A**





# STATE OF NEW YORK DEPARTMENT OF HEALTH

Center for Environmental Health

2 University Place

Albany, New York 12203-3399

Mark R. Chassin, M.D., M.P.P.,  
Commissioner  
Paula Wilson  
Executive Deputy Commissioner

RECEIVED  
DEC 29 2 13 PM '94  
USE TO  
REMOVAL AND  
PREPAREDNESS PROGRAMS

November 30, 1994

## OFFICE OF PUBLIC HEALTH

Lloyd F. Novick, M.D., M.P.H.  
Director

Diana Jones Ritter  
Executive Deputy Director

William N. Stasiuk, P.E., Ph.D.  
Center Director

Ms. Kathleen C. Callahan, Director  
Emergency & Remedial Response Division  
United States Environmental  
Protection Agency  
Region II  
26 Federal Plaza  
New York, New York 10278

RE: Mitigating Potential Exposures  
~~Pyridium Mercury Site #33~~  
NYSDOH Site #336822N  
(V)Harriman, Orange County

Dear Ms. Callahan:

On October 21, 1994, my staff investigated a report of a possible second Pyridium Mercury Disposal site at 40 South Main Street in the Village of Harriman, Orange County. A mother and her two children, ages 6 and 7, are the only current residents. Allegedly, eight to fifteen truckloads of the Pyridium wastes were used as fill in the front yard of a single family residence during the early 1950's. Shoveled test holes were dug with the assistance of the property owner and the Village of Harriman Code Enforcement Officer. A Nepera, Inc. official was present during this preliminary inspection. Whitish gray Pyridium-like wastes were discovered a few inches below the ground surface at several locations in the front yard of this late 1800's home. Surface wastes were observed only where a large willow tree root broke through the grass cover. This spot was immediately covered over by investigators to minimize casual contact.

At our request, the United States Environmental Protection Agency (EPA) collected one surface soil, two subsurface soil, and two subsurface waste samples on October 26, 1994. The results of the testing demonstrated that there are significantly elevated levels of mercury in the subsurface wastes (two samples: 227 and 456 parts per million (ppm) of total mercury). The surface soil sample collected within the fenced yard, where the two children and family dog spend much of their play time, contained 27.5 ppm of total mercury. Because mercury is typically found in soils at levels less than 1 ppm, we and a representative of the federal Agency for Toxic Substances and Disease Registry recommended confirmatory surface soil sampling within the play yard. On October 29, 1994 the EPA collected nine additional surface soil (0 to 3 inches below any vegetative cover) samples to further assess the extent of surface contamination so that appropriate public health decisions could be made. Total mercury levels ranged from 0.1 to 117 ppm with an average of 35.1 ppm. Mercury contamination appears to increase markedly from the front porch outward.



toward the reported area of historic waste disposal. Based on field observations, less obvious mercury contamination detected in surface soils within the fenced play area may be the direct result of the family's pet repeatedly digging in the yard.

Exposure to either inorganic or organic mercury can permanently damage the brain, kidneys, and developing fetus. The most sensitive target of low-level exposure to inorganic mercury appears to be the kidneys. Exposure to mercury in the soil can occur through a number of routes. There is the potential for direct oral exposure via ingestion of soil, dust, and garden produce grown in contaminated soil. Mercury can be absorbed into the body via dermal contact through activities associated with soil disturbances such as gardening, yard work, and play. The potential for inhalation of mercury particulates and mercury vapor is also a concern.

The elevated levels of mercury in soil are a public health concern. To minimize potential human exposure to these chemical wastes, the tenant and the property owner have been advised to avoid physical contact with front yard soils and to avoid disturbing any soils whatsoever. Based on the results of the EPA's follow-up sampling, the mother has been advised to keep her children and dog out of the fenced play area. Vegetable gardening is not recommended. These temporary advisories should be followed by a permanent solution as the presence of these wastes on a residential property pose a current and future threat to public health.

With this information, I am seeking the EPA's assistance in reducing or eliminating the conditions causing this potential human health hazard in the Village of Harriman. I am further asking that the EPA either enter into an Order on Consent with Nepera, Inc. or else respond to this situation using federal Superfund monies to assure that the presence of this hazardous substance within a residential neighborhood is satisfactorily addressed to eliminate the exposure potential. It is important to note that as a result of public meetings and media attention associated with the first Pyridium Mercury Disposal (trailer park) site which is just up the road, the community has a heightened desire for a thorough investigation and clean-up of this property as well as any others that may be discovered with similar wastes in the future.

We look forward to working with the EPA toward a satisfactory resolution of this sensitive public health issue. Should you wish to discuss the matter further, do not hesitate to contact me at (518) 458-6310.

Sincerely,



G. Anders Carlson, Ph.D.  
Director  
Bureau of Environmental Exposure  
Investigation



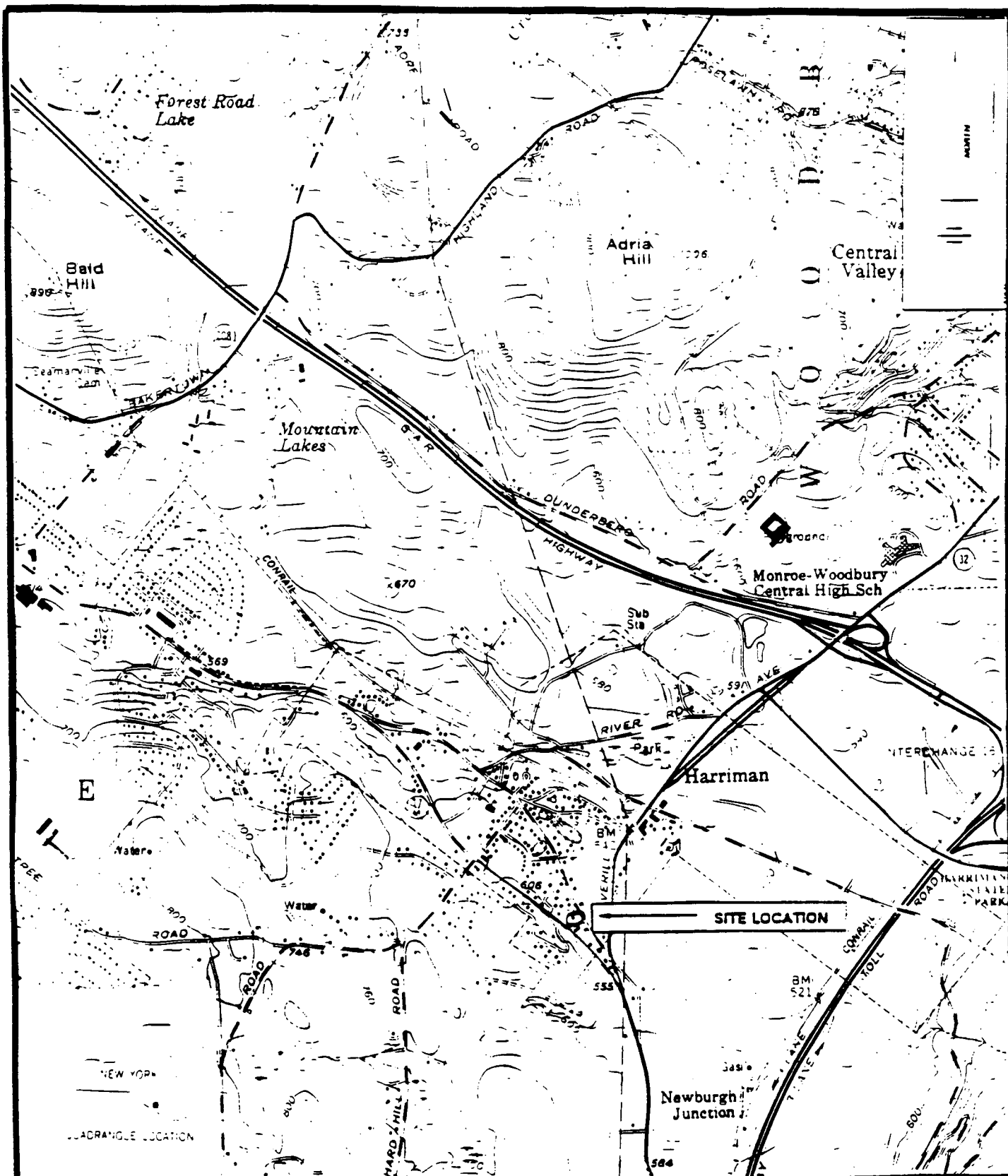
sms/94300PRO0671

cc: Dr. N. Kim  
Mr. S. Bates/Mr. M. Valkenburg  
Mr. J. Crua  
Mr. M. Knudsen  
Ms. N. Knapp  
Mr. S. Abrams  
Mr. M. Schleifer - OCHD  
Mr. M. O'Toole - DEC  
Mr. S. Ervolina/ Ms. S. McCormick - DEC  
Mr. A. Klauss - DEC Region 3  
Mr. G. Zachos/Mr. J. Rotola - EPA Region II  
Mr. A. Block/Mr. S. Jones - ATSDR  
Mr. D. Humphrey - Mayor of Harriman



**APPENDIX B**





Roy F. Weston, Inc.  
MAJOR PROGRAMS DIVISION

IN ASSOCIATION WITH FOSTER WHEELER CORP.,  
C.C JOHNSON & MALHOTRA, P.C., RESOURCE  
APPLICATIONS, INC. AND R.E. SARRIERA ASSOCIATES

EPA PM

D. HARKAY

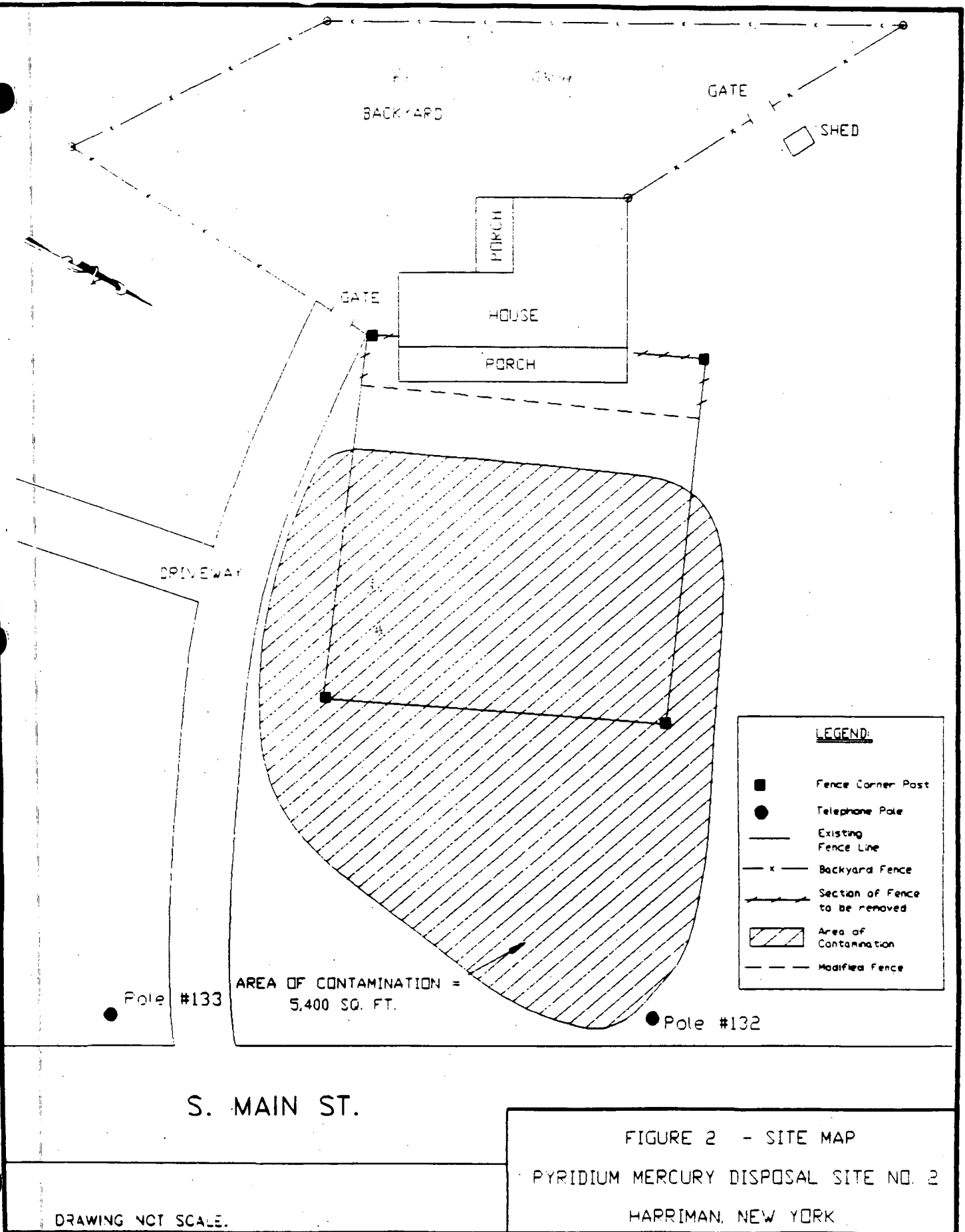
FIGURE 1  
SITE LOCATION MAP

TAT PM

S: MAY

PYRIDIUM MERCURY  
DISPOSAL SITE NO. 2







**APPENDIX C**

PLEASE REFER TO SECTION 4, PM2 - 4.1001 - 4.1026 FOR THE FINAL HEALTH ASSESSMENT



**SAMPLING REPORT  
PYRIDIUM MERCURY DISPOSAL SITE NO. 2**

**VILLAGE OF HARRIMAN  
ORANGE COUNTY, NEW YORK**

**OCTOBER 1994**

**Prepared for:**

**U.S. Environmental Protection Agency  
Region II Removal Action Branch  
Joseph Rotola, On-Scene Coordinator**

**Prepared by:**

**Roy F. Weston, Inc.  
Technical Assistance Team**



**Eric Wilson  
Project Manager**



**Tom O'Neill  
QC Review**



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## 1. INTRODUCTION

### 1.1 Site Background

The Pyridium Mercury Disposal Site No.2 is a residential property located at the west corner of the intersection of Ramapo Lane and South Main Street in the Village of Harriman, Orange County, New York.

The U.S. Environmental Protection Agency (EPA) was notified by the New York State Department of Health and the Village of Harriman, that material similar to that found at the Pyridium Mercury Disposal Site No.1 was present at this property. Waste found at the Pyridium Mercury Disposal Site No.1 has been found to contain mercury at concentrations as high as 656 mg/kg.

### 1.2 Sampling Objectives

The EPA Region II On-Scene Coordinator (OSC) tasked the Roy F. Weston, Inc. Technical Assistance Team (TAT) with conducting an investigation to identify the presence of mercury in surface soils at the site.

## 2. METHODOLOGY

### 2.1 Sampling Summary

Sampling was conducted on October 26 and 29, 1994. Soil borings were advanced to make a visual determination of the existence of waste. Soil samples were collected and delivered to a laboratory for analysis for total mercury.

### 2.2 Soil Borings

Soil borings were advanced using a hand shovel and hand auger. If grass was present at the boring location, the turf was cut and removed to reveal the underground soils. Borings were advanced to a minimum depth of 12 inches below existing grade. Observations were recorded in the field logbook. In some cases, soil samples were collected from the bore holes. After completion of the soil boring, soil was replaced and compacted, and the turf was replaced.

Tools used to advance the bore holes were cleaned with water between borings.

A map depicting soil boring and sampling locations is included as Figure I.



### 2.3 Soil Sampling

In all cases where soil borings and sampling were conducted at the same location, soil borings were performed first. In cases where a surface soil sample was collected at a boring location, a separate boring was advanced adjacent to the observation bore hole for collection of the sample. This precaution was taken to avoid cross contaminating surface soils with underlying waste.

Soil samples were collected using dedicated, disposable, plastic scoops. Samples were placed in precleaned sample jars, capped and labeled. Sample chain of custody procedures were followed for all samples. Samples were delivered by hand to ICM Laboratories, Randolph, New Jersey for analysis for total mercury.

## 3.0 RESULTS

### 3.1 Soil Borings

The results of soil borings and sample descriptions are presented in Table 1.

### 3.2 Soil Sampling for Total Mercury

The results of analysis of soil and waste samples for total mercury are presented in Table 2.

## 4.0 DISCUSSION OF RESULTS

The results of the analysis for total mercury have been reviewed and meet the quality assurance criteria for QA2 as defined in Quality Assurance/Quality Control Guidance for Removal Activities (EPA 540/G-90/004, April 1990). These data are useable, as qualified.

Waste samples SB4-1, SB5-1 and SB5-2 have been found to contain mercury at concentrations of 227, 434 and 477 mg/kg respectively.

Surface soil sample SS-1, collected October 26, 1994 from the fenced in portion of the front yard revealed trace quantities of a white material that was presumed to be waste. This sample was analyzed and found to contain 27.5 mg/kg of mercury. Nine additional surface soil samples were collected on October 29, 1994; these samples were collected in a rectangular grid pattern, with 20 foot spacing between samples. With the exception of sample location N50W50, all samples were found to contain mercury at levels above the concentration range of mercury found in uncontaminated soil in the Albany, New York area (Reference 1). A map showing the mercury concentration at each sampling location is included as Figure II.



Table-1 Soil Boring/Sample Description

PM 2 - 1.3007

Boring ID	Description
SS-1	0-1 inch, topsoil mixed with white particulate. Grab soil sample SS-1 collected 0-1 inch below ground surface.
Boring #1	Boring advanced to 18 inches below grade. No waste observed.  No sample collected.
Boring #2	Boring advanced to 14 inches below grade. No waste observed.  Grab soil sample SB2-1 collected from 0-3 inches below ground surface.
Boring #3	Boring advanced to 12 inches below grade. No waste observed.  Grab soil sample SB3-1 collected from 0-3 inches below ground surface.
Boring #4	Boring advanced to 18 inches below grade. Waste observed from 3-18 inches.  Grab waste sample SB4-1 collected at a depth of 3-6 inches below grade.
Boring #5	Boring advanced to 12 inches below grade. Waste observed from 1-12 inches, lower limit of waste not found.  Grab waste sample SB5-1 and duplicate SB5-2 collected 1 to 6 inches below grade.
N10W10	Boring advanced to 36 inches below grade. 0-9 inches - topsoil. 9-24 inches - white pasty solid. 24-36 inches - soil mixed with small stone.  Grab soil sample N10W10 collected 0-3 inches below ground surface.
N10W30	Boring advanced to 18 inches below grade. 0-14 inches - topsoil. 14-18 inches - white pasty solid.  Grab soil sample N10W30 collected 0-3 inches below ground surface.
N10W50	Boring advanced to 20 inches below grade. 0-20 inches - topsoil mixed with white granular material (similar to soil extender).  Grab soil sample N10W50 collected 0-3 inches below ground surface.



Table 1-Soil Boring/Sample Descriptions (continued) PM 2 - 1.3008.

Boring ID	Description
N30W10	<p>Boring advanced to a minimum of 6 inches below ground surface. 0-6 inches - topsoil. Waste encountered at 6 inches below ground surface.</p> <p>Grab soil sample N30W10 collected 0-3 inches below ground surface.</p>
N30W30	<p>Boring advanced to 22 inches below ground surface. 0-10 inches - topsoil. 10-18 inches - white pasty solid mixed with black ash. 18-22 inches - soil mixed with construction debris.</p> <p>Grab soil sample N30W30 collected 0-3 inches below ground surface.</p>
N30W50	<p>Boring advanced to 26 inches below ground surface. 0-6 inches - topsoil mixed with wood chips. No waste observed.</p> <p>Grab soil sample N30W50 collected 0-3 inches below ground surface.</p>
N50W10	<p>Boring advanced to 18 inches below ground surface. 0-18 inches - topsoil. No waste observed.</p> <p>Grab soil sample N50W10 collected 0-3 inches below ground surface.</p>
N50W30	<p>Boring advanced to 18 inches below ground surface. 0-12 inches - topsoil. 12-18 inches - white pasty solid mixed with debris.</p> <p>Grab soil sample N50W30 collected 0-3 inches below ground surface.</p>
N50W50	<p>Boring advanced to 18 inches below ground surface. 0-18 inches - topsoil mixed with rocks.</p> <p>Grab soil sample N50W50 and duplicate N50W50-A collected at 0-3 inches below ground surface.</p>



Table 2

## Mercury Concentration in Soil and Waste

Sample ID	Mercury Conclusion (mg/kg)
SS-1	27.5
SB2-1	0.14
SB3-1	0.16
SB4-1	227
SB5-1	434
SB5-2	477
N10W10	117
N10W30	41.5
N10W50	1.0
N30W10	111
N30W30	11.9
N30W50	2.1
N50W10	7.2
N50W30	23.4
N50W50	0.06B
N50W50-A	0.06B

B - Indicates sample was detected at a concentration greater than the method detection limit and less than the method quantitation limit. Concentrations are estimates.



## 5.0 CONCLUSIONS

1. The white pasty solid found on site is similar in appearance and contains similar quantities of mercury as the waste found at the Pyridium Mercury Disposal Site No. 1.
2. Mercury contamination is widespread in surface soils within the fenced-in portion of the front yard of the residence located on site.

## 6.0 REFERENCES

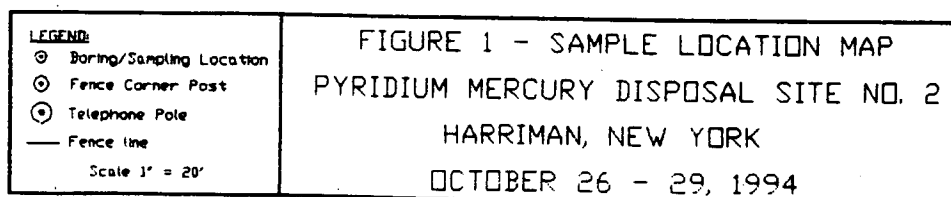
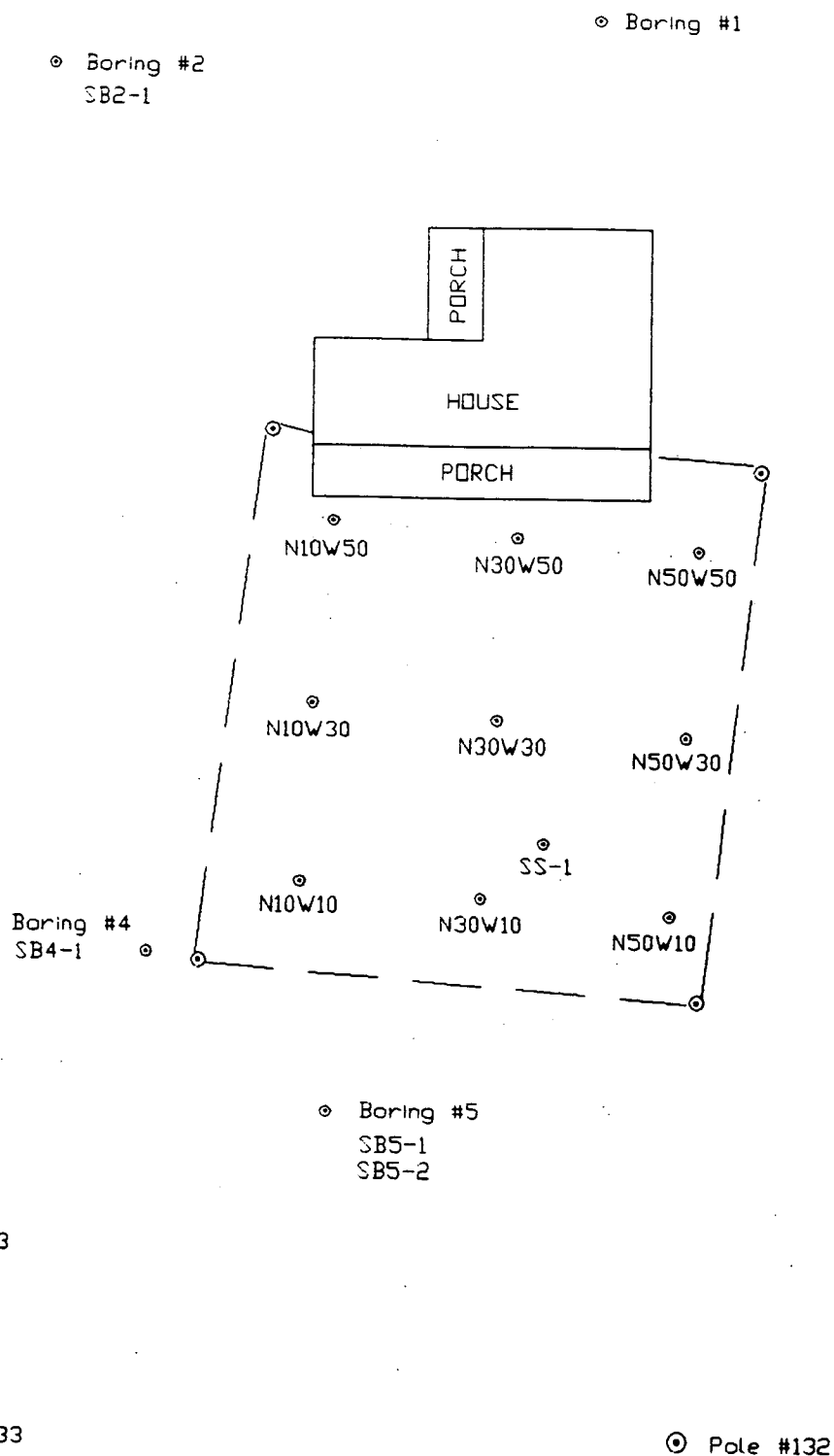
1. Shacklette, Hansford T. and Josephine G. Boerngen. 1984. Elemental Concentrations in Soils and Other Surficial Materials in the Conterminous United States. U.S. Geological Survey Professional Paper 574-D Vol 713-715A.



**ATTACHMENT 1**

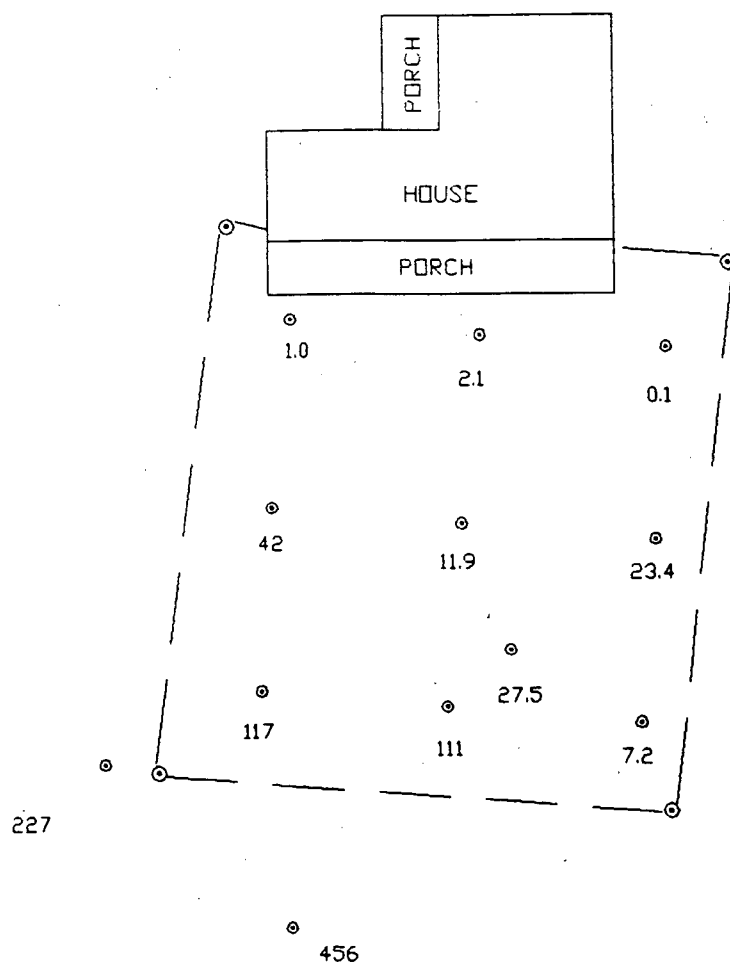
**FIGURES**







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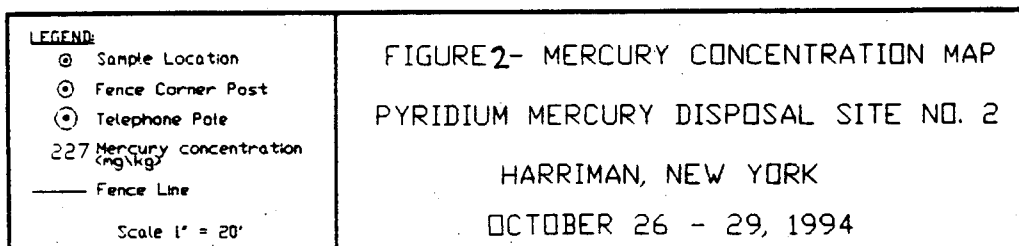


227

0.2

⊙ Pole #133

⊙ Pole #132









## POST EXCAVATION SAMPLING QA/QC WORK PLAN

PYRIDIUM MERCURY DISPOSAL SITE No. 2  
VILLAGE of HARRIMAN  
ORANGE COUNTY, NEW YORK

Prepared for

United States Environmental Protection Agency  
Region II - Removal Action Branch  
Edison, New Jersey 08837

Prepared by

Superfund Technical Assessment and Response Team  
Roy F. Weston, Inc.  
Federal Programs Division  
Edison, New Jersey 08837DCN #: START-02-F-00026  
TDD #: 95-10-0035  
PCS #: 1037  
EPA Contract NO.: 68-W5-0019

## Approvals:

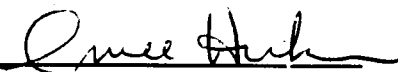
START

  
START Project ManagerDate: 12/1/95

START

  
START QCDate: Dec 1, 1995

EPA

  
On-Scene Coordinator

Date: \_\_\_\_\_



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Appendix B	Post Excavation Sampling Map
Appendix C	Soil Sampling SOP



## 1.0 BACKGROUND

The Pyridium Mercury Disposal Site No. 2 is a residential property located at 40 South Main Street, Village of Harriman, Orange County, New York (See Appendix A). The site is a ¼-acre residential property, back-filled with mercury-contaminated industrial waste. The site includes a two-story, farmhouse pre-dating the waste disposal activities. For the past three years, a family has rented the farmhouse.

In the early 1950's approximately 8 to 15 truckloads of waste were allegedly dumped in an L-shaped pattern in the front yard. The waste was allegedly a mercuric or mercurous salt generated during the production of niacinamide (Vitamin B-3) by the former Pyridium Corporation. The waste was used to back-fill low-lying areas of the front yard. Part of the mercury waste disposal area by the front porch was later fenced.

Site investigations, conducted by the EPA and the New York State Department of Health (NYSDOH) in October and December 1994, indicated approximately 500 cubic yards of waste were used as back-fill. Analytical results of the waste samples indicate elevated mercury concentrations, as high as 477 milligrams per kilogram (mg/kg). Previous studies show typical soil background mercury concentrations to be less than 1 mg/kg in this geographic location.

In January 1995, a Draft Health Consultation Report was prepared by the NYSDOH under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The report states that the Pyridium Mercury Disposal Site No. 2 is a public health hazard due to the high mercury concentrations in the soil. Residents are suspected to be at risk of kidney damage through mercury ingestion, inhalation and dermal contact.

## 2.0 DATA USE OBJECTIVES

The objective of this sampling event is to determine if the extent of mercury contamination has been successfully removed to cleanup levels adopted for the Pyridium Mercury site.

## 3.0 QUALITY ASSURANCE OBJECTIVES

As identified in Sections 1.0 and 2.0 the objective of this project/event applies to the following parameters:

<u>Parameters</u>	<u>Matrix</u>	<u>Intended Data Use</u>	<u>QA Objective</u>
Mercury	Soil	Verify attainment of cleanup levels	QA-2



## 4.0 APPROACH AND SAMPLING METHODOLOGIES

### 4.1 Sampling Equipment

The following equipment will be utilized to obtain environmental samples from the respective media/matrix:

<u>Parameter</u>	<u>Sampling Equipment</u>	<u>Fabrication</u>	<u>Dedicated</u>
Mercury	Disposable Scoop	Plastic	Yes

All sample containers will be Eagle-Pitcher Brand pre-cleaned laboratory glassware, as specified by the EPA Sample Management Office Contract Lab Program. Separate sampling equipment will be dedicated for use at each sample location to eliminate the need for equipment decontamination. Rinsate samples will not be needed since sampling equipment will not be decontaminated and reused. Plastic scoops will be wiped clean after use to prevent the possible spread of existing contamination. Plain paper napkins will be utilized for the wipe-down process. All sampling spoons and used protective clothing will be bagged and stored on site for disposal during future remedial or removal actions.

### 4.2 Sampling Design

The primary contaminant of concern at this site is mercury. This metal is the most widespread contaminant at the site and has been chosen as the target compound to define the limits of excavation.

One sample will be taken every 30 linear feet around the perimeter of the excavation. Each sample will be taken from the bottom of the sidewall where the bottom and the sidewall meet. In addition to the perimeter sampling, one sample will be taken at the bottom of the excavation approximately every 900 square feet. A total of 18 samples will be obtained (See Appendix B for proposed sample locations). All sampling activities will be performed by Region II START under the supervision of the EPA On-Scene-Coordinator (OSC). Tables 1 and 2 outline the analytical parameters and number of samples to be collected, respectively.

**Table 1: Analytical Parameters**

Analytical Parameters	Number of Sample Locations	Sample Matrix Conc.	Sample Prep./ Analytical Methods	Sample Preservation	Holding Time	Clean-up Levels
Mercury	18	Soil/low conc.	To be Determined	None	No holding time	25 ppm Hg



Table 2: Mercury Sample Totals

MERCURY	SITE
Number of mercury sample locations	18 samples
Quantity and container size/location	2 x 8 oz.
Number of Environmental Duplicates	1 per 20 samples
Number of Matrix Spike samples	1 per 20 samples
Number of Performance Evaluation (PE) samples	N/A
TOTAL Number of mercury samples	38 samples

### 4.3 Standard Operating Procedures

#### 4.3.1 Sample Documentation

All sample documents must be completed legibly, in ink. Any corrections or revisions must be made by lining through the incorrect entry and by initiating the error.

#### FIELD LOG BOOK

The Field Log Book is essentially a descriptive notebook detailing site activities and observations so that an accurate account of field procedures can be reconstructed in the writer's absence. All entries should be dated and signed by the individuals making the entries, and should include (at a minimum) the following:

1. Site name and project number.
2. Name(s) of personnel on site.
3. Dates and times of all entries (military time preferred).
4. Descriptions of all site activities, including site entry and exit times.
5. Note worthy events and discussions.
6. Weather conditions.
7. Site observations.
8. Identification and description of samples and locations.



9. Subcontractor information and names of on-site personnel.
10. Date and time of sample collections, along with chain-of-custody information.
11. Record of photographs.
12. Site sketches.

### **SAMPLE LABELS**

Sample labels must clearly identify the particular sample, and should include the following:

1. Site name and number.
2. Date and time sample was taken.
3. Sample preservation.
4. Initial of sampler(s).
5. Brief sample description.

Optional, but pertinent, information:

1. Analysis requested.
2. Sample location.

Sample labels must be securely affixed to the sample container. Tie-on labels can be used if properly secured.

### **CHAIN OF CUSTODY RECORD**

A Chain of Custody record must be maintained from the time the sample is taken to its final deposition. Every transfer of custody must be noted and signed for, and a copy of this record kept by each individual who has signed. When samples (or groups of samples) are not under direct control of the individual responsible for them, they must be stored in a locked container sealed with a Chain of Custody seal.

The Chain of Custody record should include (at minimum) the following:

1. Sample identification number.
2. Sample information.
3. Sample location.
4. Sample date.
5. Sample description.



6. Laboratory analysis.
7. Laboratory name and address.
8. Name(s) and signature(s) of sampler(s).
9. Signature(s) of any individual(s) with control over the samples.

#### CHAIN OF CUSTODY SEALS

Chain of Custody Seals demonstrate that a sample container has not been tampered with, or opened. The individual in possession of the sample(s) must sign and date the seal, affixing it in such a manner that the container cannot be opened without breaking the seal. The name of this individual, along with a description of the sample packaging, must be noted in the Field Logbook.

The Chain of Custody Record is employed as physical evidence of sample custody. One Record accompanies each properly labelled and DOT-packaged sample shipping container from the field to the laboratory. In Region II, the Environmental Services Division Chain of Custody Record is used.

The DOT packaged shipping containers are secured and custody seals are placed across the package openings. As long as custody forms are sealed inside the sample cooler and the custody seals remain intact, commercial carriers and are not required to sign off on the custody form.

Samples split between two different laboratories must be correctly labeled with separate tags and sample identification stickers, provided by the laboratories.

If errors are made when completing any of these forms, the error must be crossed out with a single line, initiated and dated by the sampler.

#### 4.3.2 Soil Sampling SOPs

Collection of surface soil samples will be accomplished with a disposable plastic scoop. Prior to the collection of the sample, surface debris will be removed with a decontaminated sampling tool.

A 12" X 12" square area will be marked out with a measuring tape at the sample location. The sample will be collected from a depth of 0 to 3 inches. The soil will be mixed thoroughly in place prior to transferring to the designated labeled container. See Attachment C for additional requirements for soil sampling procedures.



#### 4.3.3 Sample Handling and Shipment

Each of the sample bottles will be sealed and labeled according to the following protocol. Caps will be secured with custody seals. Bottle labels will contain all required information including the sample number, time and date of collection, analysis requested, sample description and any preservative used. Sealed bottles will be placed in large metal or plastic coolers, padded with an absorbent material such as vermiculite and cooled to a temperature of 4 °C with ice.

All sample documents will be affixed to the underside of each cooler lid. The lid will be sealed and affixed on at least two sides with EPA custody seals so that any sign of tampering is easily visible.

#### 4.4 Schedule of Activities

**Table 3: Proposed Schedule of Work**

ACTIVITY	START DATE	END DATE
Surface Soil Sampling	To Be Determined	To Be Determined

### 5.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The EPA On-Scene Coordinator, Irmee Huhn, will provide overall direction to Region II START staff concerning project sampling needs, objectives and schedule.

The Region II START Task Leader, Randy Komssi, is the primary point of contact with the EPA On-Scene Coordinator. The Task Leader is responsible for the development and completion of the Sampling QA/QC Plan, project team organization, and supervision of all project tasks, including reporting and deliverables.

The START Task Leader/Site QC Coordinator, Randy Komssi, is responsible for ensuring field adherence to the Sampling QA/QC Plan and recording any deviations.

The following sampling personnel will work on this project:

<u>Personnel</u>	<u>Affiliation</u>	<u>Responsibility</u>
Irmee Huhn	USEPA Region II	On-Scene Coordinator
Randy Komssi	START II	Sample Collection



The following laboratory will be providing the following analyses:

<u>Lab Name/Location</u>	<u>Lab Type</u>	<u>Parameters</u>
--------------------------	-----------------	-------------------

To be Determined

## **6.0 QUALITY ASSURANCE and QUALITY CONTROL REQUIREMENTS**

### **6.1 Chain of Custody**

An EPA chain of custody record will be maintained throughout the sampling program. The chain of custody form lists the following information:

- i. Sample numbers;
- ii. Number of sample containers;
- iii. Description of sample, including the specific location of sample collection, sample matrix and grab or composite sample;
- iv. Identity of person collecting the sample;
- v. Date and time of sample collection;
- vi. Type of analysis requested;
- vii. Date and time of custody transfer to laboratory by sampling personnel;
- viii. Identity of laboratory performing the analyses.

### **6.2 Laboratory Analyses**

The level of quality assurance/quality control (QA/QC) to be furnished by the contracted laboratory will be QA/QC level 2 (QA-2). In order to ensure accurate data, the following measures are required:

1. Mercury Analysis
  - a. One matrix spike analysis will be performed on one sample in each set of 20 environmental samples collected.
  - b. One duplicate sample analysis will be performed on each set of 20 environmental samples collected.



## 2. All Analysis

The contracted laboratory will furnish the following deliverables as warranted:

- a. Calibration analysis prior to analyzing calibration solutions, blanks, samples and QC samples;
- b. Preparation, extraction and/or analysis dates;
- c. Bench sheets and/or sample extraction, digestion, or distillation logs for percent solids, sample weight and final volume;
- d. Copies of all spectra data obtained during performance of analysis. Copies should be signed by the analyst and checked by the laboratory manager;
- e. The detection limit will be determined and recorded, along with the data, where appropriate; detection limits must meet the specified limits.
- f. Data system printout (quantitation report or legible facsimile GC);
- g. Spike Matrix/Duplicate and Calibration Standard Sample Recoveries;
- h. Case Narrative identifying and explaining any analytical modifications that differ from EPA protocol.

All analytical results are to be submitted by the laboratory to the designated QA/QC Officer within 12 hours of sample receipt. A written report will be submitted within 7 calendar days of sample receipt.

## 7.0 DELIVERABLES

The Region II START Task Leader, Randy Komssi, will maintain contact with the EPA On-Scene Coordinator, Irmee Huhn, to keep her informed about the technical and financial progress of this project. Activities under this project will be reported in status and trip reports and other deliverables (e.g., analytical reports, final reports) described herein.



## **TRIP REPORT**

A trip report will be prepared to provide a detailed accounting of what occurred during each sampling mobilization. The trip report will be prepared within two weeks of the last day of each sampling mobilization. Information will be provided in a timely basis for major events, dates, and personnel on site (including affiliations).

## **ANALYTICAL REPORT**

An analytical report which describes methodologies used, details analytical results, and evaluates quality control information, will be prepared.

## **MAPS/FIGURES**

The following illustration(s) will be provided:

Site Location Map  
Sample Location Map

## **8.0 DATA VALIDATION**

All steps of data generation and handling will be evaluated by the Region II START Quality Assurance Officer (QAO) for compliance with the specified requirements. The QAO will provide the finalized assembled data package to the START Task Leader and the EPA OSC.

## **9.0 SYSTEM AUDIT**

The Region II START Task Leader will ensure the sampling operations are conducted according to this sampling plan. Any deviations will be brought to the attention of the OSC and documented accordingly.

## **10.0 CORRECTIVE ACTIONS**

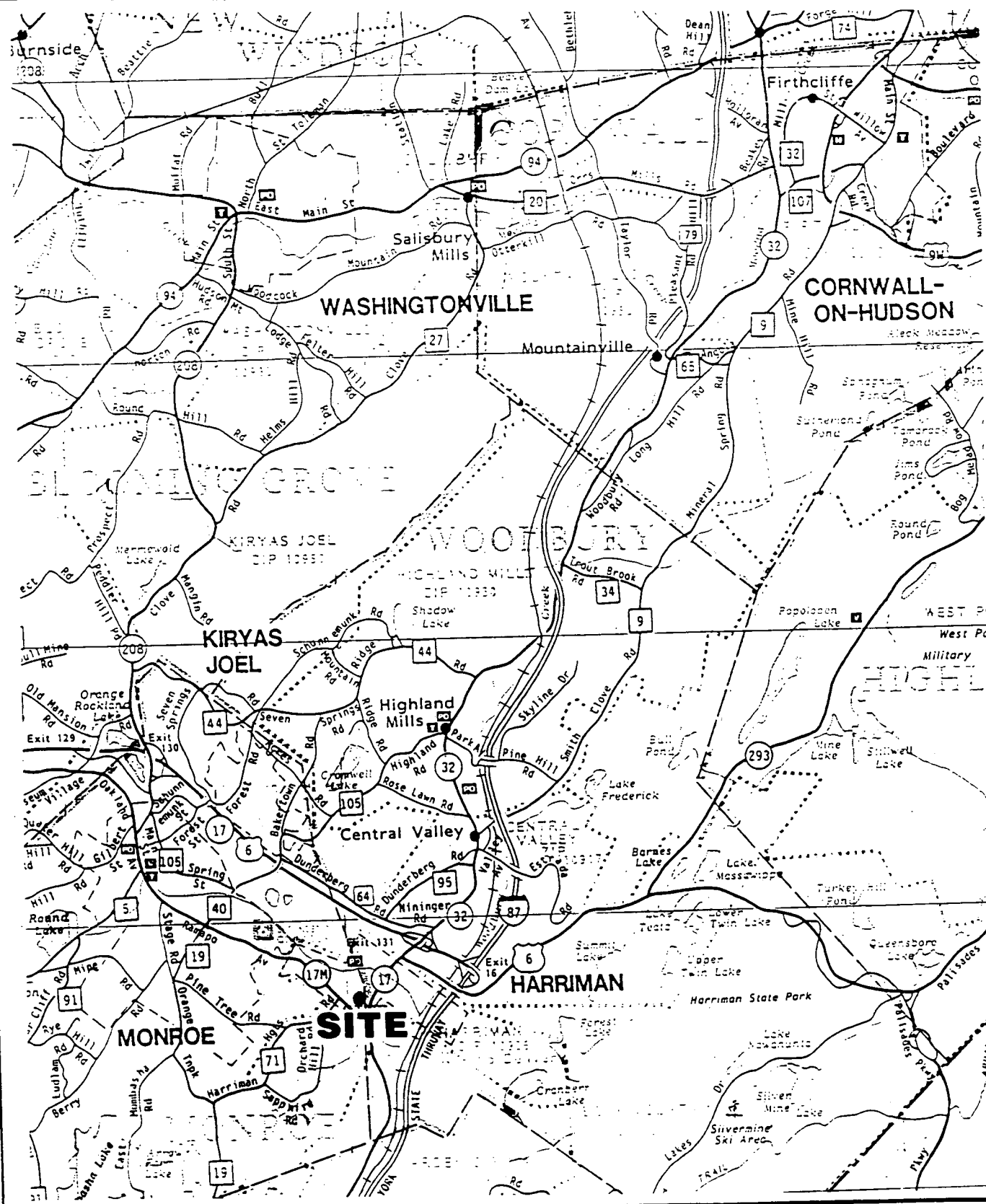
Appropriate action will be taken by the Region II START Task Leader to ensure that any problems that may develop are dealt with as quickly as possible to ensure the continuity of the sampling program. Any deviations from this sampling plan will be noted in the final trip report.



**APPENDIX A**

**Pyridium Mercury Site No. 2  
Site Location Map**





Roy F. Weston, Inc.  
MAJOR PROGRAMS DIVISION

EPA PM  
Irmee Huhn

Figure 1

IN ASSOCIATION WITH FOSTER WHEELER CORP.,  
C.C. JOHNSON & MALHOTRA, P.C., RESOURCE  
APPLICATIONS, INC. AND R.E. SARRIERA ASSOCIATES

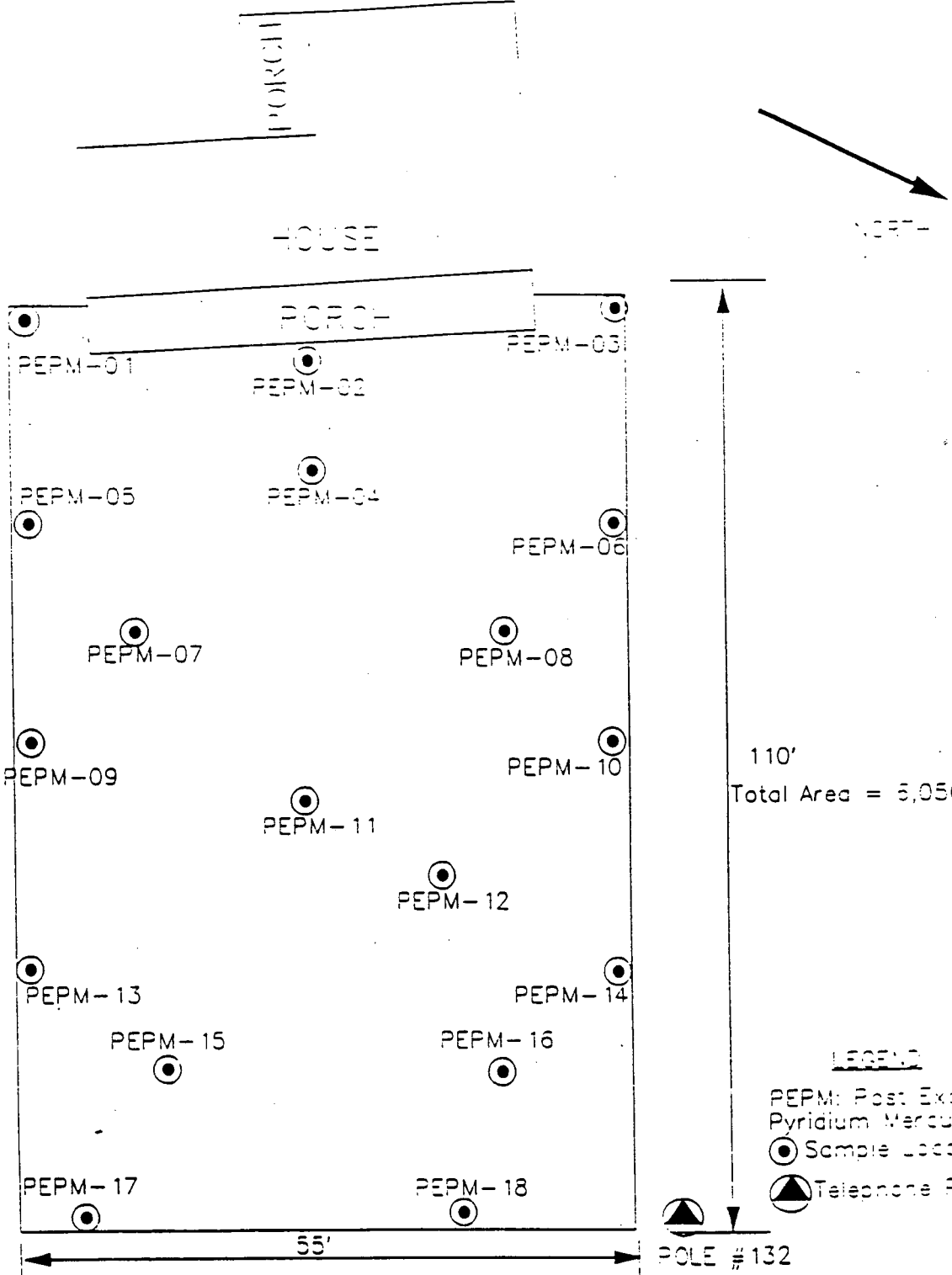
TAT PM  
Randy Komssi

Site Location  
Map



**APPENDIX B**  
**Proposed Sampling Map**





**LEGEND**

PEPM: Post Excavation  
Pyridium Mercury

● Sample Location

▲ Telephone Pole

<p><b>WESTON</b></p> <p>Roy F. Weston, Inc. FEDERAL PROGRAMS DIVISION MANAGERS DESIGNERS/CONSULTANTS</p>	<p>EPA PM IRMEE HUHN</p>	<p>SITE PYRIDUM MERCURY DISPOSAL SITE</p>
<p>IN ASSOCIATION WITH RESOURCE APPLICATIONS, INC., C.C. JOHNSON &amp; MALHOTRA, P.C., PRC ENVIRONMENTAL MANAGEMENT AND R.E. SARRERA ASSOCIATES</p>	<p>TAT PM RANDY KOMSSI</p>	<p>FIGURE 2 EXCAVATION SAMPLE MAP</p>



## **APPENDIX C**

### **Soil Sampling SOP**



## 2.0 SOIL SAMPLING: SOP #2012

### 2.1 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for collecting representative soil samples. Analysis of soil samples may determine whether concentrations of specific soil pollutants exceed established action levels, or if the concentrations of soil pollutants present a risk to public health, welfare, or the environment.

### 2.2 METHOD SUMMARY

Soil samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the depth of the desired sample, the type of sample required (disturbed versus undisturbed), and the type of soil. Near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, a trier, a split-spoon, or, if required, a backhoe.

### 2.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended. Refrigeration to 4°C, supplemented by a minimal holding time, is usually the best approach.

### 2.4 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems associated with soil sampling. These include cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results.

### 2.5 EQUIPMENT/APPARATUS

- sampling plan
- maps/plot plan

- safety equipment, as specified in the health and safety plan
- compass
- tape measure
- survey stakes or flags
- camera and film
- stainless steel, plastic, or other appropriate homogenization bucket or bowl
- 1-quart mason jars w/Teflon liners
- Ziploc plastic bags
- logbook
- labels
- chain of custody forms and seals
- field data sheets
- cooler(s)
- ice
- decontamination supplies/equipment
- canvas or plastic sheet
- spade or shovel
- spatula
- scoop
- plastic or stainless steel spoons
- trowel
- continuous flight (screw) auger
- bucket auger
- post hole auger



- extension rods
- T-handle
- sampling trier
- thin-wall tube sampler
- Vehimeyer soil sampler outfit
  - tubes
  - points
  - drive head
  - drop hammer
  - puller jack and grip
- backhoe

## 2.6 REAGENTS

Reagents are not used for the preservation of soil samples. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

## 2.7 PROCEDURES

### 2.7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are required.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or preclean equipment, and ensure that it is in working order.
4. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
6. Use stakes, buoys, or flagging to identify and mark all sampling locations. Consider specific site

factors, including extent and nature of contaminant, when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations will be utility-cleared by the property owner prior to soil sampling.

### 2.7.2 Sample Collection

#### *Surface Soil Samples*

Collect samples from near-surface soil with tools such as spades, shovels, and scoops. Surface material can be removed to the required depth with this equipment, then a stainless steel or plastic scoop can be used to collect the sample.

This method can be used in most soil types but is limited to sampling near surface areas. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sampling team member. The use of a flat, pointed mason trowel to cut a block of the desired soil can be helpful when undisturbed profiles are required. A stainless steel scoop, lab spoon, or plastic spoon will suffice in most other applications. Avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as potting trowels.

Follow these procedures to collect surface soil samples.

1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
3. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a



stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled container(s) and secure the cap(s) tightly.

#### ***Sampling at Depth with Augers and Thin-Wall Tube Samplers***

This system consists of an auger, a series of extensions, a "T" handle, and a thin-wall tube sampler (Appendix A, Figure 1). The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin-wall tube sampler. The system is then lowered down the borehole, and driven into the soil at the completion depth. The system is withdrawn and the core collected from the thin-wall tube sampler.

Several types of augers are available. These include: bucket, continuous flight (screw), and posthole augers. Bucket augers are better for direct sample recovery since they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights, which are usually at 5-foot intervals. The continuous flight augers are satisfactory for use when a composite of the complete soil column is desired. Posthole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil.

Follow these procedures for collecting soil samples with the auger and a thin-wall tube sampler.

1. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first 3 to 6 inches of surface soil for an area approximately 6 inches in radius around the drilling location.
3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
4. After reaching the desired depth, slowly and carefully remove the auger from boring. When sampling directly from the auger, collect sample after the auger is removed from boring and proceed to Step 10.
5. Remove auger tip from drill rods and replace with a pre-cleaned thin-wall tube sampler. Install proper cutting tip.
6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring as the vibrations may cause the boring walls to collapse.
7. Remove the tube sampler, and unscrew the drill rods.
8. Remove the cutting tip and the core from the device.



9. Discard the top of the core (approximately 1 inch), as this represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container(s). Sample homogenization is not required.
10. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into the appropriate, labeled container(s) and secure the cap(s) tightly.
11. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.
12. Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

#### *Sampling at Depth with a Trier*

The system consists of a trier, and a "T" handle. The auger is driven into the soil to be sampled and

used to extract a core sample from the appropriate depth.

Follow these procedures to collect soil samples with a sampling trier:

1. Insert the trier (Appendix A, Figure 2) into the material to be sampled at a (0° to 45° angle from horizontal. This orientation minimizes the spillage of sample.
2. Rotate the trier once or twice to cut a core of material.
3. Slowly withdraw the trier, making sure that the slot is facing upward.
4. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly.

#### *Sampling at Depth with a Split Spoon (Barrel) Sampler*

The procedure for split spoon sampling describes the collection and extraction of undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may



be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted.

When split tube sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D 1586-67 (reapproved 1974).

Follow these procedures for collecting soil samples with a split spoon.

1. Assemble the sampler by aligning both sides of the barrel and then screwing the bit onto the bottom and the heavier head piece onto the top.
2. Place the sampler in a perpendicular position on the sample material.
3. Using a sledge hammer or well ring, if available, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.
4. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.
5. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in diameters of 2 and 3 1/2 inches. However, in order to obtain the required sample volume, use of a larger barrel may be required.
6. Without disturbing the core, transfer it to an appropriate labeled sample container(s) and seal tightly.

### *Test Pit/Trench Excavation*

These relatively large excavations are used to remove sections of soil, when detailed examination of soil characteristics (horizontal structure, color, etc.) are required. It is the least cost effective sampling method due to the relatively high cost of backhoe operation.

Follow these procedures for collecting soil samples from test pit/trench excavations.

1. Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of utility lines and poles (subsurface as well as above surface).
2. Using the backhoe, dig a trench to approximately 3 feet in width and approximately 1 foot below the cleared sampling location. Place removed or excavated soils on plastic sheets. Trenches greater than 5 feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.
3. Use a shovel to remove a 1- to 2-inch layer of soil from the vertical face of the pit where sampling is to be done.
4. Take samples using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket.
5. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder



of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled container(s) and secure the cap(s) tightly.

6. Abandon the pit or excavation according to applicable state regulations. Generally, shallow excavations can simply be backfilled with the removed soil material.

## 2.8 CALCULATIONS

This section is not applicable to this SOP.

## 2.9 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following QA procedures apply:

- All data must be documented on field data sheets or within site logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

## 2.10 DATA VALIDATION

This section is not applicable to this SOP.

## 2.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.



**SAMPLING TRIP REPORT**

**SITE NAME:** Pyridium Mercury Disposal Site No. 2  
 DCN : START-02-F-00100  
 TDD #: 95-10-0035  
 PCS #: 1076

**EPA I.D. NO.:** EZ

**SAMPLING DATES:** 12/4/95 through 12/14/95

1. Site Location Map: Refer to Figure 1
2. Sample Locations: Refer to Figure 2
3. Sample Descriptions: Refer to Table 1
4. Laboratories Receiving Samples:

Matrix

Soil

Name and Address of Laboratory

Adirondack Environmental Services  
 314 North Pearl St.  
 Albany, NY 12207

**5. Sample Dispatch Data:**

The following details sample collection at the site during this month:

DATE	TIME	# of SAMPLES	SAMPLE TYPE	ANALYSIS
December 4, 1995	1315	1	Tree Bark	Total Mercury
December 8, 1995	1400	9	Soil	Total Mercury
December 8, 1995	1630	2	Debris	Total Mercury
December 13, 1995	1630	15	Soil	Total Mercury
December 14, 1995	1625	3	Soil	Total Mercury

All samples delivered to laboratory by Leadfoot Carriers.



**6. On-Site Personnel:**

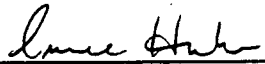
<u>Name</u>	<u>Affiliation</u>	<u>Responsibilities on Site</u>
Randy Komssi	Region II START	Project Manager/Sampler
Irmee Huhn	Region II EPA	On-Scene Coordinator
Tracy Walker	Region II ERCS	Response Manager

**7. Weather Conditions:**

For the duration of the sampling event, the temperature ranged between 15 to 40°F. Cold conditions generated a frost line beneath the surface at approximately 0 - 4" thick. From December 14, 1995 and on, there was approximately 4 to 6" of snow on the ground.

**8. Additional Comments:**

Due to subfreezing temperatures and the depth of the frost line, perimeter samples, which were designated to be taken at a depth of 0 - 3" were obtained below the frost line. A total of 24 soil samples were collected, which included three field samples for duplicates analysis. In addition, three matrix spike/matrix spike duplicate (MS/MSD) samples were collected to meet EPA QA/QC Level 2 objectives. All samples were collected using 4 oz. disposable plastic scoops and placed in clear 8 oz. jars.

**9. Report Prepared by:** Randy KomssiDate: 12/27/95**10. Report Reviewed by:** Date: 4/18/96**11. Report Approved by:** Date: 4/26/96



**TABLE 1**  
**SAMPLE DESCRIPTIONS**  
**PYRIDIUM MERCURY DISPOSAL SITE No. 2**  
**HARRIMAN, NEW YORK**  
**SAMPLING DATES: 12/4/95 TO 12/14/95**

SAMPLE NUMBER	DATE	TIME	MATRIX	SAMPLE TYPE	ANALYSIS	SAMPLE DEPTH	LOCATION AND DESCRIPTION
T-01	12/4/95	1201	bark, wood chips	grab	mercury	NA	weeping willow tree
D-01	12/7/95	1600	soil/debris	grab	mercury	2'-2'3"	see map for location cement-like debris
D-02	12/7/95	1605	soil/debris	grab	mercury	2'-2'3"	see map for location cement-like debris
PE-01-A	12/8/95	1235	soil	grab	mercury	0-3"	south wall/ brown/silty
PE-01-B	12/8/95	1240	soil	grab	mercury	8"-1'	south wall/ brown/silty
PE-02-A	12/8/95	1245	soil	grab	mercury	0-3"	in front of house/ brown/silty
PE-02-B	12/8/95	1247	soil	grab	mercury	1'10"-2'	in front of house/ brown/silty
PE-03-A*	12/8/95	1245	soil	grab	mercury	0-3"	northwest corner/ brown/silty
PE-03-B	12/8/95	1247	soil	grab	mercury	2'-2'3"	northwest corner/ light brown/clay
PE-04-A	12/8/95	1249	soil	grab	mercury	0-3"	northwest wall/ brown/silty
PE-04-B	12/8/95	1250	soil	grab	mercury	1'10"-2'	northwest wall/ light brown/clay
PE-05-B**	12/8/95	1330	soil	grab	mercury	2'-2'3"	northwest corner/ light brown/clay Dupe of PE-03-B
PE-06-A *	12/13/95	0945	soil	grab	mercury	0-3"	northwest wall/ brown/silty-loam
PE-06-B	12/13/95	1000	soil	grab	mercury	1'3"-1'6"	northwest wall/ brown/silty
PE-07-A	12/13/95	1020	soil	grab	mercury	2-6"	north corner/ light brown/frozen
PE-08-A	12/13/95	1045	soil	grab	mercury	6-10"	northeast corner/ light brown/frozen
PE-09-A**	12/13/95	1100	soil	grab	mercury	0-3"	northwest wall/ brown/silty-loam Dupe of PE-06-A
PE-10	12/13/95	1335	soil	grab	mercury	2'6"-2'9"†	see map for location frozen/some debris
PE-11	12/13/95	1400	soil	grab	mercury	2'-2'3"†	see map for location frozen/some debris

\* MS/MSD Sample - Indicates that extra sample volume was collected and shipped to the laboratory for MS/MSD analysis.

\*\* Field duplicate sample.

† Bottom excavation sample



**TABLE 1**  
**SAMPLE DESCRIPTIONS**  
**PYRIDIUM MERCURY DISPOSAL SITE No. 2**  
**HARRIMAN, NEW YORK**  
**SAMPLING DATES: 12/4/95 TO 12/14/95**

SAMPLE NUMBER	DATE	TIME	MATRIX	SAMPLE TYPE	ANALYSIS	SAMPLE DEPTH	LOCATION AND DESCRIPTION
PE-12	12/13/95	1330	soil	grab	mercury	3'-3'3"†	see map for location frozen/some debris
PE-13	12/13/95	1200	soil	grab	mercury	1'6"-1'9"†	see map for location frozen/some debris
PE-14	12/13/95	1405	soil	grab	mercury	1'6"-1'9"†	see map for location frozen/some debris
PE-15	12/13/95	1400	soil	grab	mercury	1'-1'3"†	see map for location brown/frozen clay
PE-16-A	12/13/95	1425	soil	grab	mercury	9"-1'	northeast corner/ light brown/frozen
PE-17	12/13/95	1410	soil	grab	mercury	4'-4'4"†	see map for location brown/some debris
PE-18	12/13/95	1420	soil	grab	mercury	3'-3'3"†	see map for location brown/some debris
PE-19-A	12/13/95	1425	soil	grab	mercury	4-8"	southeast corner/ brown/frozen
PE-20-A*	12/14/95	1330	soil	grab	mercury	4-8"	northeast wall/ black/silty
PE-21-A**	12/14/95	1340	soil	grab	mercury	4-8"	northeast wall/ black/silty Dupe of PE-20-A
PE-22-A	12/14/95	1540	soil	grab	mercury	0-3"	northwest wall/ black/silty-loam

\* MS/MSD Sample - Indicates that extra sample volume was collected and shipped to the laboratory for MS/MSD analysis

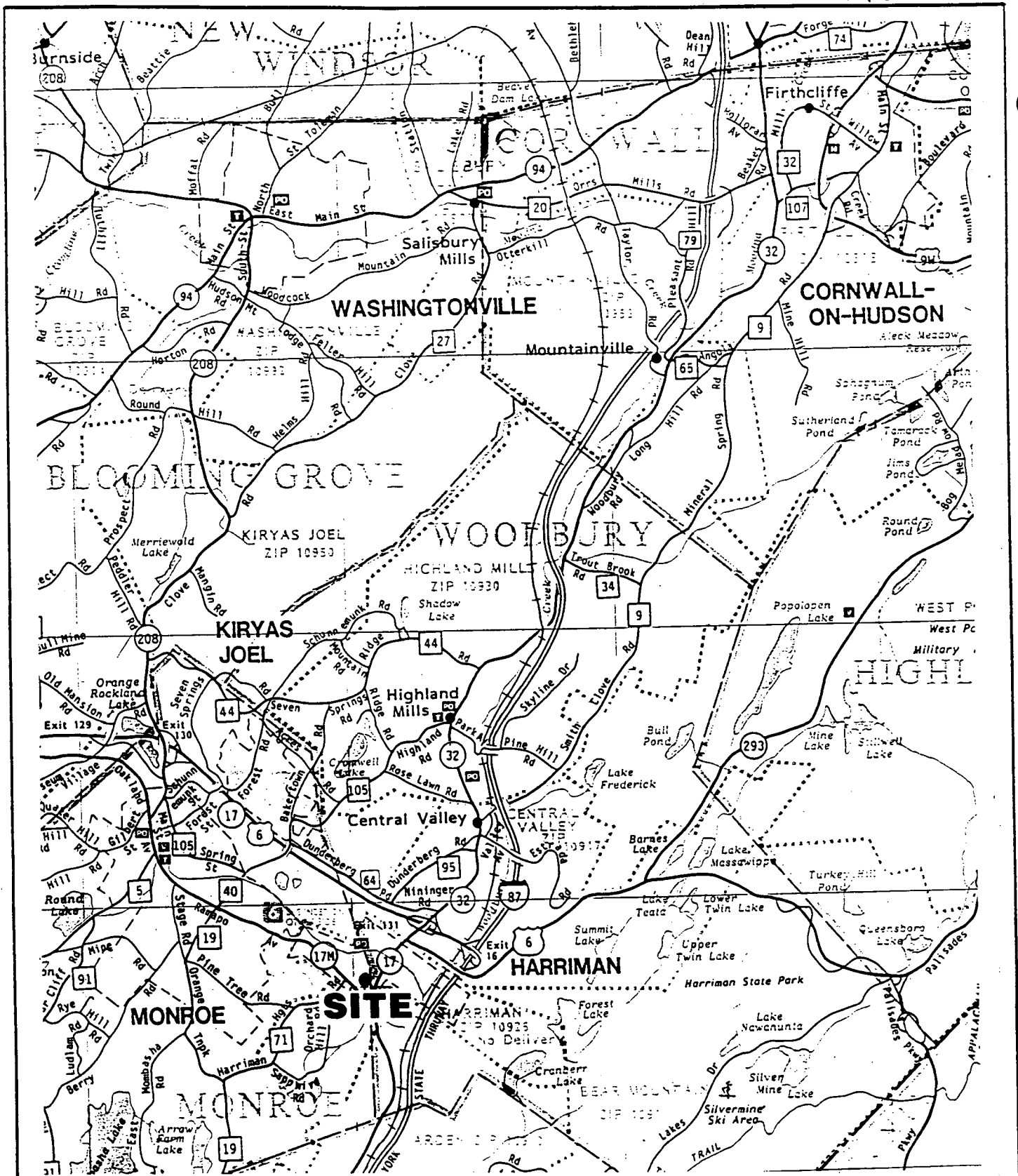
\*\* Field duplicate sample

† Bottom excavation sample



**FIGURE 1**  
**SITE LOCATION MAP**





Roy F. Weston, Inc.  
MAJOR PROGRAMS DIVISION

EPA PM  
Irmee Huhn

Figure 1

IN ASSOCIATION WITH FOSTER WHEELER CORP.,  
C.C. JOHNSON & MALHOTRA, P.C., RESOURCE  
APPLICATIONS, INC. AND R.E. SARRIERA ASSOCIATES

TAT PM  
Randy Komssi

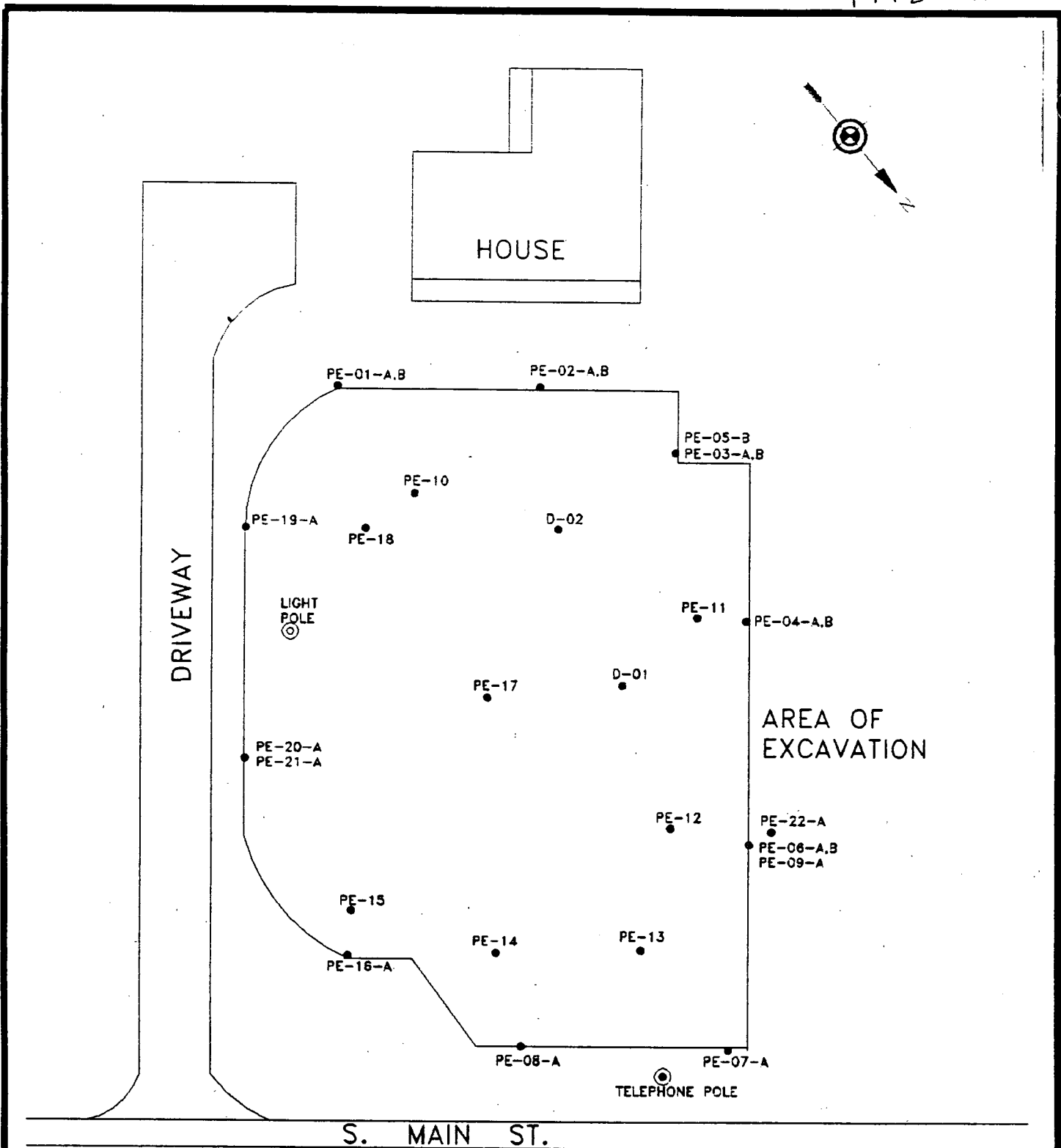
Site Location  
Map



PM 2-1.5007

**FIGURE 2**  
**SAMPLE LOCATION MAP**





SCALE: 1" = 20'



Roy F. Weston, Inc.  
FEDERAL PROGRAMS DIVISION

IN ASSOCIATION WITH RESOURCE APPLICATION, Inc.  
C.C. JOHNSON & MALHOTRA, P.C., R.E. SARRIERA ASSOCIATES,  
PRC ENVIRONMENTAL MANAGEMENT, AND GRB ENVIRONMENTAL SERVICES, INC.

EPA PM

I. HUHN

START PM

R. KOMSSI

PYRIDIUM  
MERCURY

SITE II



**SAMPLING REPORT  
EXTENT OF CONTAMINATION STUDY**

**PYRIDIUM MERCURY DISPOSAL SITE NO. 2  
VILLAGE OF HARRIMAN  
ORANGE COUNTY, NEW YORK**

**JUNE 1996**

**Prepared by:**

**U.S. Environmental Protection Agency  
Region II Removal Action Branch  
Eric Wilson, On-Scene Coordinator**

**Roy F. Weston, Inc.  
Superfund Technical Assessment and Response Team  
Kathy Campbell, Project Manager**



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## 1. INTRODUCTION

### 1.1 Site Background

The Pyridium Mercury Disposal Site No. 2 is a residential property located at the west corner of the intersection of Ramapo Lane and South Main Street in the Village of Harriman, Orange County, New York.

The U.S. Environmental Protection Agency (EPA) was notified by the New York State Department of Health and the Village of Harriman that material similar to that found at the Pyridium Mercury Disposal Site No. 1 was present at this property.

In October 1994, the Roy F. Weston Technical Assistance Team (TAT) conducted a study to quantify the concentration of mercury in surface soils at the site. The results of this study are included as Appendix A. This study concluded that:

1. The white solid found on site is similar in appearance and contains similar quantities of mercury as the waste found at the Pyridium Mercury Disposal Site No. 1; and
2. Mercury contamination is widespread in surface soils in the front yard of the residence located on site.

### 1.2 Sampling Objective

The EPA Region II On-Scene Coordinator (OSC) tasked TAT with conducting a study to determine the vertical and horizontal extent of mercury contamination at the Site.

## 2. METHODOLOGY

### 2.1 Sampling Summary

The EPA Environmental Response Team (ERT) and the Response Engineering and Analytical Contractor (REAC) assisted in the study by providing personnel and equipment for collection of subsurface soil samples. TAT provided personnel, equipment and resources for documentation of the sampling event and analysis of samples.

The sampling was conducted on December 7, 1994. Eleven soil borings were advanced to a maximum depth of 12 feet using a Geoprobe®. A total of ten samples were screened for the presence of mercury using an X-Ray Fluorescence Analyzer (XRF).



## **2.2    Soil Borings and Sampling**

Soil borehole locations were selected based on the results of the sampling conducted in October 1994.

Soil sampling was conducted in accordance with the Soil Sampling SOP #2012 (Appendix B). Soil samples were collected using 2-inch diameter split spoons, lined with acetate sleeves. The acetate sleeves were used to facilitate sample recovery and reduce the potential for cross-contamination of samples. The split spoons were advanced and recovered using a truck-mounted hydraulic ram (Geoprobe®). The soils at each borehole location were described by the Project Geologist. These borehole logs are included in Appendix C.

## **2.3    XRF Field Screening for Metals**

Samples of soils directly underlying layers containing visible waste were selected for XRF screening to delineate the vertical extent of mercury contamination. Sample preparation and XRF analysis were conducted in accordance with USEPA ERT/REAC Spectrace 9000 XRF SOP (Appendix D).

Samples were homogenized, dried, and sifted using a #20 mesh sieve, and placed in sample cups. Samples were screened for metals using a Spectrace Model 9000 XRF. Source measuring times used for analysis were 1000 seconds for the Cadmium 109 (Cd109), 10 seconds for Iron 55 (Fe55), and 10 seconds for Americium 241 (Am241). The measuring time for the Cd109 source was maximized in order to minimize the detection limit for mercury. The elements detected using the Fe55 and Am241 sources were not required for this investigation. The measuring times for these sources were minimized to reduce the time required for analysis.

Results for all 26 elements analyzed were stored in the instrument's internal memory; this data was downloaded to a computer data file for further processing. The downloaded data is presented in Appendix E. Instrument calibration and mercury results were also recorded in the instrument log book. The logbook entries are presented in Appendix F.

# **3.    RESULTS**

## **3.1    XRF Results**

The results of XRF analysis and sample descriptions are presented in Table 1. The mercury concentrations in all samples analyzed were



determined to be less than the instrument Method Detection Limit (MDL). The MDL and Method Quantitation Limit (MQL) for this sampling event were calculated to be 24 and 80 milligrams per kilogram (mg/kg), respectively (Table 2).

#### 4. DISCUSSION OF RESULTS

##### 4.1 Extent of Mercury Contamination

Waste was observed in borings A1, B1/B1A, B2, C1, C2 and C3. Thin lenses of waste were found intermixed with fill consisting of brown silt, sand, and coal, rock and brick fragments. The fill unit extends from the ground surface to a depth of 5.4 feet below ground surface at boring B2. Waste was observed from 0 to 1.5 feet below ground surface. Samples collected from soils underlying the mercury contaminated material were screened for mercury using the XRF. The mercury concentrations in all screened samples were determined to be less than the instrument MDL. No waste was observed in borings A2, A3, B3, D1 and D2. Cross sections of sample lines A, B, C & D are included as Appendix G.

The horizontal extent of mercury contamination is bounded on the north by the property line; on the east by boring A3 and South Main Street; on the south by borings D1 and D2; and on the west by surface soil samples N10W50 and N50W50 (Figures 1 & 2).

#### 5. CONCLUSIONS

Mercury-contaminated material was used to fill low-lying areas of the property. Thin layers of the material were observed intermixed with fill in the northeast property corner. Based on the results of the sampling conducted during this study, the mercury contamination appears to be limited to the top two feet of soils. The area of mercury contamination encompasses approximately 6,600 square feet. The volume of mercury contaminated soil is estimated to be 500 cubic yards. Calculations of the area of contamination and volume of contaminated soil are included as Appendix H.



**TABLES**



TABLE 1  
Results of XRF Screening for Mercury  
Sampling Conducted December 7, 1994

Sample Number	Boring Location	Sample Depth (feet)	Mercury Conc. (mg/kg)	Sample Description
A1 1.5-2.0'	A1	1.5-2.0	ND <sup>1</sup>	Brown coarse to medium sand and silt, trace fine sand and rock fragments present, loose compaction, dry.
A2 0-1.5'	A2	0-1.5	ND	Brown coarse to medium sand and silt, trace fine sand and silt, trace fine sand and rock fragments present, loose compaction, dry.
A3 1.5-2.0'	A3	1.5-2.0	ND	Fill material, large gravel and rock fragments, little coarse to medium sand, poor sorting, loose compaction, moist.
B1 1.5-3.0'	B1	1.5-3.0'	ND	Fill material, gravel, brown silt and sand, loose compaction dry. Sample collected below product lens.
B2 1.5-2.0'	B2	1.5-2.0'	ND	Mottled fill containing coal, gravel and silt. Sample collected below product lens.
B3 1.0-2.0'	B3	1.0-2.0'	ND	Mottled fill, gravel, coarse to medium sand, rock fragments, loose compaction, dry.
C1 3.0-5.0'	C1	3.0-5.0	ND	Mottled fill, coal, gravel, rocks and white flakes present; loose compaction, dry.
C3 1.0-1.5'	C3	1.0-1.5'	ND	Fill material, silt, gravel, fine sand, rock fragments, lenses and flakes of white product present, loose compaction, dry. Sample collected from below product lens.
D1 2.0'	D1	2.0	ND	Yellow brown silt and fine sand, subrounded rock fragments present, moist.
D2 2.0-2.6'	D2	2.0-2.6'	ND	Yellow brown silt and fine sand, gravel and rock fragments present, moderate compaction, moist.

<sup>1</sup> ND indicates that the analyte was not detected above the instrument detection limit of 24 mg/kg.



TABLE 2  
Results of XRF Analysis of NIST Standard 2709  
and Calculation of MDL and MQL

Sample Number	Analysis Date	Analysis Time	Measured Mercury Concentration (mg/kg)
NIST 2709 <sup>2</sup>	12/6/94	13.87	-17.1
NIST 2709	12/6/94	15.10	-26.7
NIST 2709	12/6/94	17.96	-21.1
NIST 2709	12/7/94	9.18	-11.5
NIST 2709	12/7/94	9.51	-18.3
NIST 2709	12/7/94	11.69	-35.6
NIST 2709	12/7/94	12.06	-12.6
NIST 2709	12/7/94	14.47	-23.3

Population Standard Deviation =  $O_{n-1} = [(x_i^2 - (x_i)^2/n)/(n - 1)]^{1/2} = 8$

Method Detection Limit =  $3[O_{n-1}] = 24$

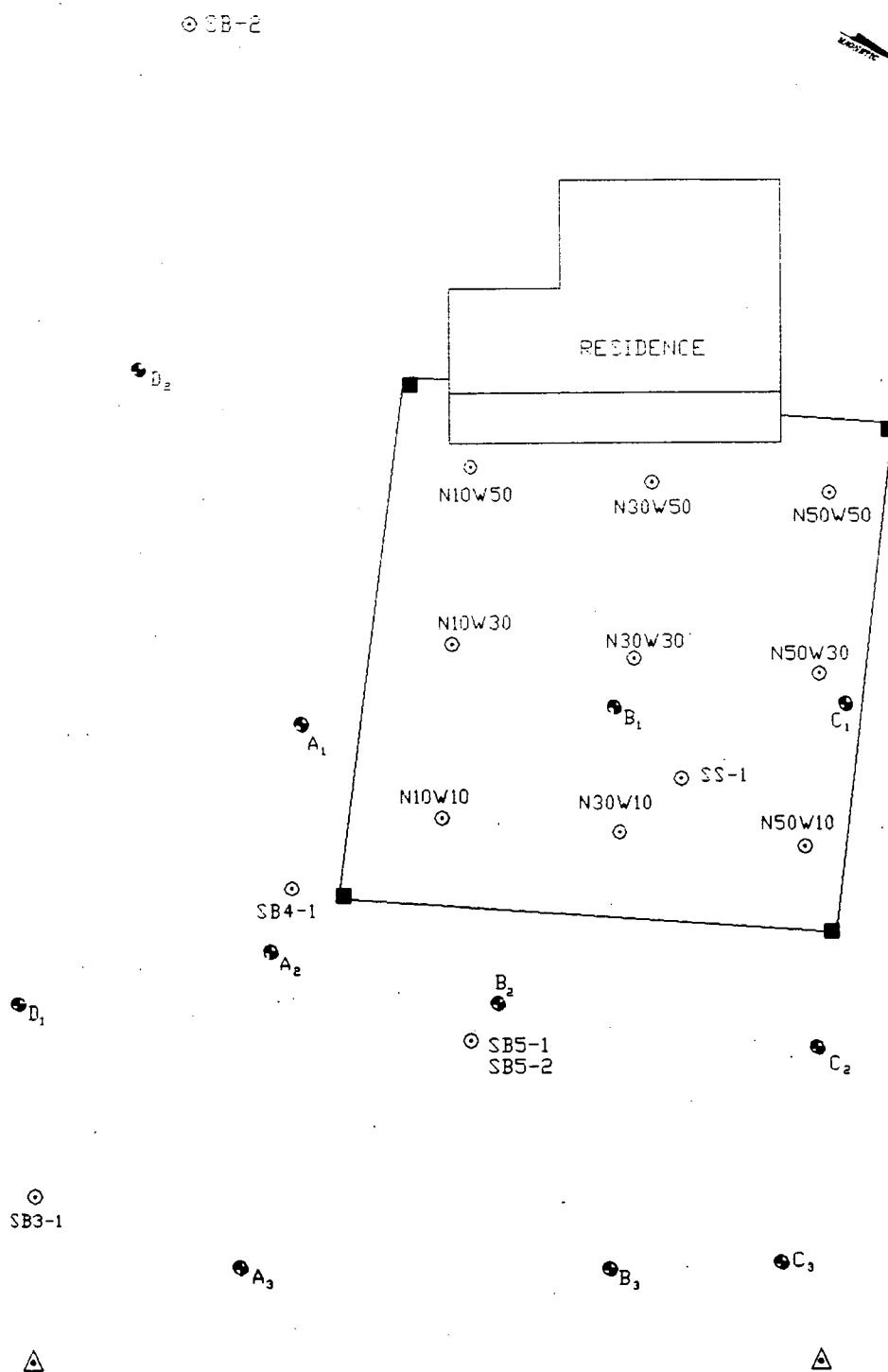
Method Quantitation Limit =  $10[O_{n-1}] = 80$

<sup>2</sup>The NIST Certificate of Analysis for Standard Reference Material 2709 is included as Appendix I.



**FIGURES**





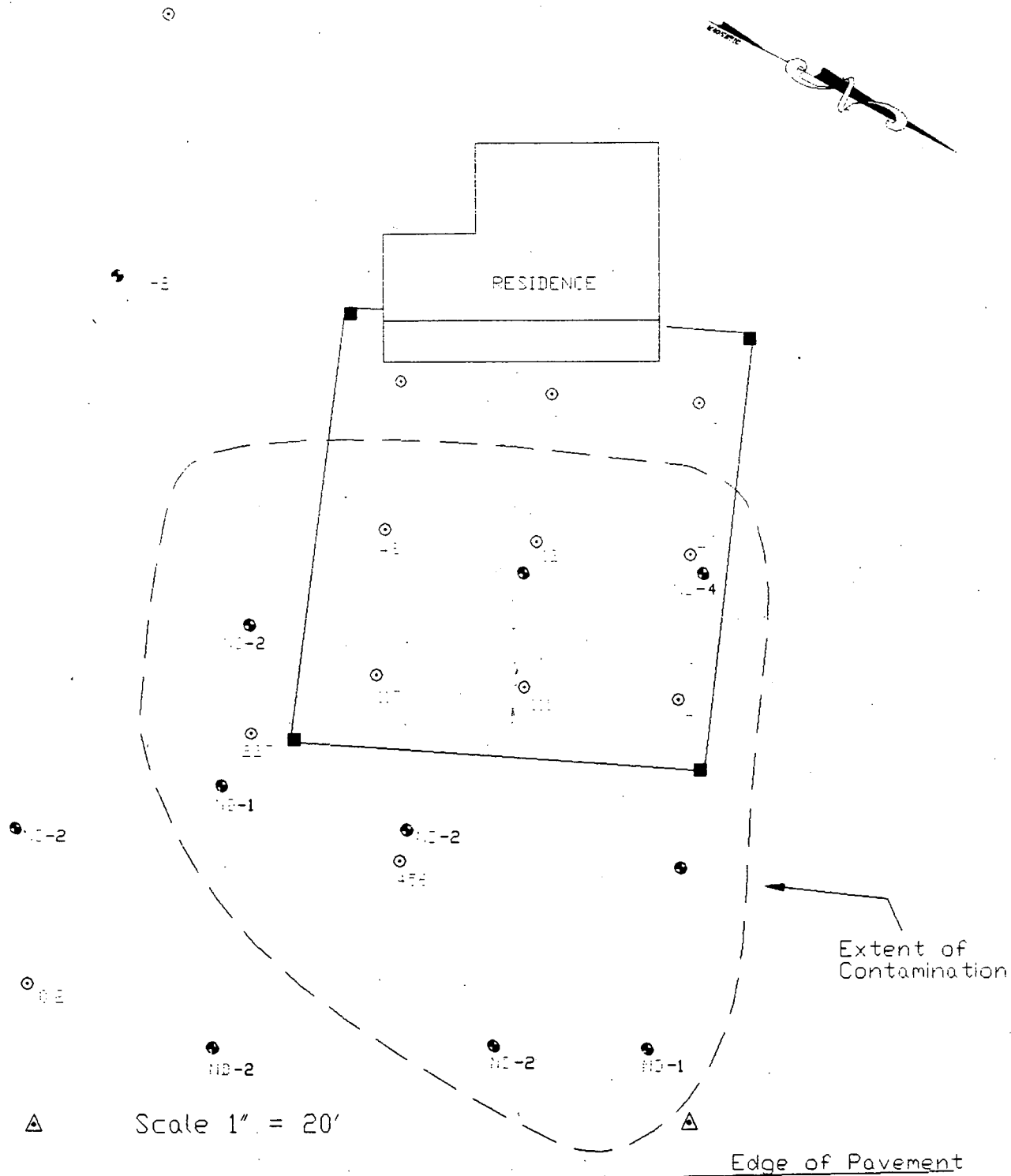
Scale 1" = 20'

LEGEND:

- ⊙ Surface Soil Sample Location (10/94)
- ⊗ Soil Boring Location (12/94)
- △ Utility Pole
- Fence Corner Post
- Fence Line

FIGURE 1 - SAMPLE LOCATION MAP  
PYRIDIDIUM MERCURY DISPOSAL SITE NO. 2  
HARRIMAN, NEW YORK  
OCTOBER & DECEMBER 1994





## LEGEND:

- Surface Soil Sample Location  
Mercury Concentration (mg/kg)
- Soil Boring Location  
Mercury Concentration (mg/kg) - Depth (ft)
- △ Utility Pole
- Fence Corner Post
- Limit of Contamination

FIGURE 2 - SAMPLE RESULTS AND  
EXTENT OF CONTAMINATION

PYRIDIUM MERCURY DISPOSAL SITE NO. 2

HARRIMAN, NEW YORK

OCTOBER & DECEMBER 1994



**APPENDIX A**  
**RESULTS OF SOIL SAMPLING - OCTOBER 1994**



Table A1  
Soil Boring/Sample Description  
Pyridium Mercury Disposal Site No. 2 - Harriman NY  
October 1994

Boring ID	Description
SS-1	0-1 inch, topsoil mixed with white particulate.  Grab soil sample SS-1 collected 0-1 inch below ground surface.
Boring #1	Boring advanced to 18 inches below grade. No waste observed.  No sample collected.
Boring #2	Boring advanced to 14 inches below grade. No waste observed.  Grab soil sample SB2-1 collected from 0-3 inches below ground surface.
Boring #3	Boring advanced to 12 inches below grade. No waste observed.  Grab soil sample SB3-1 collected from 0-3 inches below ground surface.
Boring #4	Boring advanced to 18 inches below grade. Waste observed from 3-18 inches.  Grab waste sample SB4-1 collected at a depth of 3-6 inches below grade.
Boring #5	Boring advanced to 12 inches below grade. Waste observed from 1-12 inches, lower limit of waste not found.  Grab waste sample SB5-1 and duplicate SB5-2 collected 1 to 6 inches below grade.
N10W10	Boring advanced to 36 inches below grade. 0-9 inches - topsoil. 9-24 inches - white pasty solid. 24-36 inches - soil mixed with small stone.  Grab soil sample N10W10 collected 0-3 inches below ground surface.



Table A1  
Soil Boring/Sample Description  
Pyridium Mercury Disposal Site No. 2 - Harriman NY  
October 1994

Boring ID	Description
N10W30	<p>Boring advanced to 18 inches below grade. 0-14 inches - topsoil. 14-18 inches - white pasty solid.</p> <p>Grab soil sample N10W30 collected 0-3 inches below ground surface.</p>
N10W50	<p>Boring advanced to 20 inches below grade. 0-20 inches - topsoil mixed with white granular material (similar to soil extender).</p> <p>Grab soil sample N10W50 collected 0-3 inches below ground surface.</p>
N30W10	<p>Boring advanced to a minimum of 6 inches below ground surface. 0-6 inches - topsoil. Waste encountered at 6 inches below ground surface.</p> <p>Grab soil sample N30W10 collected 0-3 inches below ground surface.</p>
N30W30	<p>Boring advanced to 22 inches below ground surface. 0-10 inches - topsoil. 10-18 inches - white pasty solid mixed with black ash. 18-22 inches - soil mixed with construction debris.</p> <p>Grab soil sample N30W30 collected 0-3 inches below ground surface.</p>
N30W50	<p>Boring advanced to 26 inches below ground surface. 0-6 inches - topsoil mixed with wood chips. No waste observed.</p> <p>Grab soil sample N30W50 collected 0-3 inches below ground surface.</p>
N50W10	<p>Boring advanced to 18 inches below ground surface. 0-18 inches - topsoil. No waste observed.</p> <p>Grab soil sample N50W10 collected 0-3 inches below ground surface.</p>



Table A1  
Soil Boring/Sample Description  
Pyridium Mercury Disposal Site No. 2 - Harriman NY  
October 1994

Boring ID	Description
N50W30	<p>Boring advanced to 18 inches below ground surface. 0-12 inches - topsoil. 12-18 inches - white pasty solid mixed with debris.</p> <p>Grab soil sample N50W30 collected 0-3 inches below ground surface.</p>
N50W50	<p>Boring advanced to 18 inches below ground surface. 0-18 inches - topsoil mixed with rocks.</p> <p>Grab soil sample N50W50 and duplicate N50W50-A collected at 0-3 inches below ground surface.</p>



Table A2  
Results of Analysis  
Pyridium Mercury Disposal Site No. 2 - Harriman NY  
October 1994

Sample ID	Mercury Concentration (mg/kg)
SS-1	27.5
SB2-1	0.14
SB3-1	0.16
SB4-1	227
SB5-1	434
SB5-2	477
N10W10	117
N10W30	41.5
N10W50	1.0
N30W10	111
N30W30	11.9
N30W50	2.1
N50W10	7.2
N50W30	23.4
N50W50	0.06B
N50W50-A	0.06B

B - Indicates sample was detected at a concentration greater than the method detection limit and less than the method quantitation limit. Concentrations are estimates.



**APPENDIX B**  
**SOIL SAMPLING SOP #2012**



## 2.0 SOIL SAMPLING: SOP #2012

### 2.1 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for collecting representative soil samples. Analysis of soil samples may determine whether concentrations of specific soil pollutants exceed established action levels, or if the concentrations of soil pollutants present a risk to public health, welfare, or the environment.

### 2.2 METHOD SUMMARY

Soil samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the depth of the desired sample, the type of sample required (disturbed versus undisturbed), and the type of soil. Near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, a trier, a split-spoon, or, if required, a backhoe.

### 2.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended. Refrigeration to 4°C, supplemented by a minimal holding time, is usually the best approach.

### 2.4 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems associated with soil sampling. These include cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results.

### 2.5 EQUIPMENT/APPARATUS

- sampling plan
- maps/plot plan

- safety equipment, as specified in the health and safety plan
- compass
- tape measure
- survey stakes or flags
- camera and film
- stainless steel, plastic, or other appropriate homogenization bucket or bowl
- 1-quart mason jars w/Teflon liners
- Ziploc plastic bags
- logbook
- labels
- chain of custody forms and seals
- field data sheets
- cooler(s)
- ice
- decontamination supplies/equipment
- canvas or plastic sheet
- spade or shovel
- spatula
- scoop
- plastic or stainless steel spoons
- trowel
- continuous flight (screw) auger
- bucket auger
- post hole auger



- extension rods
- T-handle
- sampling trier
- thin-wall tube sampler
- Vehimeyer soil sampler outfit
  - tubes
  - points
  - drive head
  - drop hammer
  - puller jack and grip
- backhoe

## 2.6 REAGENTS

Reagents are not used for the preservation of soil samples. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

## 2.7 PROCEDURES

### 2.7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are required.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or preclean equipment, and ensure that it is in working order.
4. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.
6. Use stakes, buoys, or flagging to identify and mark all sampling locations. Consider specific site

factors, including extent and nature of contaminant, when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations will be utility-cleared by the property owner prior to soil sampling.

### 2.7.2 Sample Collection

#### *Surface Soil Samples*

Collect samples from near-surface soil with tools such as spades, shovels, and scoops. Surface material can be removed to the required depth with this equipment, then a stainless steel or plastic scoop can be used to collect the sample.

This method can be used in most soil types but is limited to sampling near surface areas. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sampling team member. The use of a flat, pointed mason trowel to cut a block of the desired soil can be helpful when undisturbed profiles are required. A stainless steel scoop, lab spoon, or plastic spoon will suffice in most other applications. Avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as potting trowels.

Follow these procedures to collect surface soil samples.

1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
3. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a



stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled container(s) and secure the cap(s) tightly.

#### ***Sampling at Depth with Augers and Thin-Wall Tube Samplers***

This system consists of an auger, a series of extensions, a "T" handle, and a thin-wall tube sampler (Appendix A, Figure 1). The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin-wall tube sampler. The system is then lowered down the borehole, and driven into the soil at the completion depth. The system is withdrawn and the core collected from the thin-wall tube sampler.

Several types of augers are available. These include: bucket, continuous flight (screw), and posthole augers. Bucket augers are better for direct sample recovery since they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights, which are usually at 5-foot intervals. The continuous flight augers are satisfactory for use when a composite of the complete soil column is desired. Posthole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil.

Follow these procedures for collecting soil samples with the auger and a thin-wall tube sampler.

1. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first 3 to 6 inches of surface soil for an area approximately 6 inches in radius around the drilling location.
3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
4. After reaching the desired depth, slowly and carefully remove the auger from boring. When sampling directly from the auger, collect sample after the auger is removed from boring and proceed to Step 10.
5. Remove auger tip from drill rods and replace with a pre-cleaned thin-wall tube sampler. Install proper cutting tip.
6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring as the vibrations may cause the boring walls to collapse.
7. Remove the tube sampler, and unscrew the drill rods.
8. Remove the cutting tip and the core from the device.



9. Discard the top of the core (approximately 1 inch), as this represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container(s). Sample homogenization is not required.
10. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into the appropriate, labeled container(s) and secure the cap(s) tightly.
11. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.
12. Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

#### ***Sampling at Depth with a Trier***

The system consists of a trier, and a "T" handle. The auger is driven into the soil to be sampled and

used to extract a core sample from the appropriate depth.

Follow these procedures to collect soil samples with a sampling trier:

1. Insert the trier (Appendix A, Figure 2) into the material to be sampled at a (0° to 45° angle from horizontal. This orientation minimizes the spillage of sample.
2. Rotate the trier once or twice to cut a core of material.
3. Slowly withdraw the trier, making sure that the slot is facing upward.
4. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly.

#### ***Sampling at Depth with a Split Spoon (Barrel) Sampler***

The procedure for split spoon sampling describes the collection and extraction of undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may



be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted.

When split tube sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D 1586-67 (reapproved 1974).

Follow these procedures for collecting soil samples with a split spoon.

1. Assemble the sampler by aligning both sides of the barrel and then screwing the bit onto the bottom and the heavier head piece onto the top.
2. Place the sampler in a perpendicular position on the sample material.
3. Using a sledge hammer or well ring, if available, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.
4. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.
5. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in diameters of 2 and 3 1/2 inches. However, in order to obtain the required sample volume, use of a larger barrel may be required.
6. Without disturbing the core, transfer it to an appropriate labeled sample container(s) and seal tightly.

### *Test Pit/Trench Excavation*

These relatively large excavations are used to remove sections of soil, when detailed examination of soil characteristics (horizontal structure, color, etc.) are required. It is the least cost effective sampling method due to the relatively high cost of backhoe operation.

Follow these procedures for collecting soil samples from test pit/trench excavations.

1. Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of utility lines and poles (subsurface as well as above surface).
2. Using the backhoe, dig a trench to approximately 3 feet in width and approximately 1 foot below the cleared sampling location. Place removed or excavated soils on plastic sheets. Trenches greater than 5 feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.
3. Use a shovel to remove a 1- to 2-inch layer of soil from the vertical face of the pit where sampling is to be done.
4. Take samples using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket.
5. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap(s) tightly. Place the remainder



of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into an appropriate, labeled container(s) and secure the cap(s) tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled container(s) and secure the cap(s) tightly.

6. Abandon the pit or excavation according to applicable state regulations. Generally, shallow excavations can simply be backfilled with the removed soil material.

## 2.8 CALCULATIONS

This section is not applicable to this SOP.

## 2.9 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following QA procedures apply:

- All data must be documented on field data sheets or within site logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

## 2.10 DATA VALIDATION

This section is not applicable to this SOP.

## 2.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and specific health and safety procedures.



**APPENDIX C**  
**BOREHOLE LOGS**



1146 - 1.503



Site Name: <i>Pineview #2</i>	Boring #: <i>F-1</i>	Page 1 of 1
Location: <i>2014000</i>	W.A.:	Date Started: <i>2/2/84</i>
Town/State: <i>Chattanooga TN</i>	Surface Elevation:	Date Completed: <i>2/2/84</i>
Drilling Contractor: <i>USP/REAL</i>	Sampler: <i>2014000-3200</i>	
Drilling Equipment: <i>100 ft</i>	Field Geologist: <i>J. S. Felt</i>	
Drilling Method:	Driller: <i>J. S. Felt</i>	

Sample						OVA/ HNu (ppm)	COMMENTS
Depth (Ft.)	# Interval	Blows	Penetr/ Recov.	"N" Value	Sample Description		
0.0	1	0-4	-	23	10 - Total 1st 5' section 79 mm IL		Sample
0.5					SILT 75% 2/3 coarse fine sand		-1 15-2'
1.0					medium coarse sand some silt & clay		
1.5					water proofed 15.5" section		
2.0					75% 2/3 coarse medium sand		
2.5					and SILT to fine sand, pebbles		
3.0					small clumps of organic matter		oil fill?
3.5					took up 5.0 inches to water level		
4.0	2	4-8		4/24	large clumps of Org.		
4.5					23 - "Total 1st 10" Sand etc		
5.0					above (sand) 4.5"		
5.5					in south basin 10 yr 2/6		
6.0					SILT thin fine sand and		
6.5					clay, some rounded small		
7.0					pebbles		
7.5							
8.0							
8.5							
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36.0							



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

## Well Drilling and Installation Log

Site Name: <i>Johnson #2</i>	Boring #: <i>1-2</i>	Page: of
Location: <i>Reservoir</i>	W.A.:	Date Started: <i>Nov 1</i>
Town/State: <i>San Marcos, CA</i>	Surface Elevation:	Date Completed:
Drilling Contractor: <i>San Marcos</i>	Sampler:	
Drilling Equipment: <i>1000 ft</i>	Field Geologist: <i>Ken F. Hays</i>	
Drilling Method:	Driller: <i>John F. Hays</i>	

Sample					Sample Description	OVA/ HNu (ppm)	COMMENTS
Depth (Ft.)	#	Interval Blows	Penetr/ Recov.	"N" Value			
0	1	0-1	4/1.5		19" Total 15" 3" 30mm 6mm 6		
1.5					SILT 75% 3 30mm 6mm		
1.0					more present 10" 30mm 6mm 5/3		
1.5					coarse to med Sand and gravel		
2.0					SILT 75% fine sand present, gravel		
2-5					more present 10" 30mm 6mm		
3.0					10" 30mm 6mm 10" 30mm 6mm		
3.5					concretion 0.1		
4.0	2	4-8	4/1		12" Same as above		
4.5					large rock fragments		
5.0					present		
5.5							
6.0							
6.5							
7.0							
7.5							
8.0	3	8-12	4/1.5		12" Total Same as above		
8.5					3" loose 2" in silty content at		
9.0					top of core larger rock fragments		
9.5					to bottom		
10.0							
10.5							
11.0							
11.5							
12.0							
12.5					end of boring		



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

**Well Drilling and Installation Log**

Site Name: <i>1000 7th St</i>	Boring #: <i>13</i>	Page 1 of
Location: <i>1000 7th St</i>	W.A.:	Date Started: <i>12/2/94</i>
Town/State: <i>1000 7th St</i>	Surface Elevation:	Date Completed: <i>12/7/94</i>
Drilling Contractor: <i>2 1/2 1/2</i>	Sampler: <i>1 1/2 1/2</i>	
Drilling Equipment: <i>1 1/2 1/2</i>	Field Geologist: <i>1 1/2 1/2</i>	
Drilling Method:	Driller: <i>1 1/2 1/2</i>	

Depth (Ft.)	Sample			Penetr/ Recov.	"N" Value	Sample Description	OVA/ HNu (ppm)	COMMENTS
	#	Interval	Blows					
1	0-4			4/2		Top 4' 13" of 1000 7th St		<i>Sample 173 15-21</i>
2						175 7th St 1000 7th St		
3						1000 7th St 1000 7th St		
4						1000 7th St 1000 7th St		
5						1000 7th St 1000 7th St		
6						1000 7th St 1000 7th St		
7						1000 7th St 1000 7th St		
8						1000 7th St 1000 7th St		
9						1000 7th St 1000 7th St		
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12						1000 7th St 1000 7th St		
13						1000 7th St 1000 7th St		
14						1000 7th St 1000 7th St		
15						1000 7th St 1000 7th St		
16						1000 7th St 1000 7th St		
17						1000 7th St 1000 7th St		
18						1000 7th St 1000 7th St		
19						1000 7th St 1000 7th St		
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28						1000 7th St 1000 7th St		
29						1000 7th St 1000 7th St		
30						1000 7th St 1000 7th St		
31						1000 7th St 1000 7th St		
32						1000 7th St 1000 7th St		
33						1000 7th St 1000 7th St		
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49						1000 7th St 1000 7th St		
50						1000 7th St 1000 7th St		

*end of boring 1*



[illegible]



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

**Well Drilling and Installation Log**

Site Name: <i>2001-001-102</i>	Boring #: <i>102-1</i>	Page 1 of 1
Location: <i>2001-001-102</i>	W.A.:	Date Started: <i>2/1/04</i>
Town/State: <i>2001-001-102</i>	Surface Elevation:	Date Completed: <i>12/7/04</i>
Drilling Contractor: <i>2001-001-102</i>	Sampler: <i>2001-001-102</i>	
Drilling Equipment: <i>2001-001-102</i>	Field Geologist: <i>2001-001-102</i>	
Drilling Method:	Driller: <i>2001-001-102</i>	

Depth (Ft.)	Sample			Penetr/ Recov.	"N" Value	Sample Description	OVA/ HNu (ppm)	COMMENTS
	#	Interval	Blows					
0.5								
1.0								
1.5								
2.0								
2.5								
3.0								
3.5								
4.0	24-5			4/2		15-15" 100% dark present. 100% sand, 100% gravel gravel 100% present. Brown 15-15" 5/3 silt + sand present.		2-40s 3-1-15-3 B1-35-2
4.5								
5.0								
5.5								
6.0								
6.5								
7.0								
7.5								
8.0								
8.5								
9.0								
9.5								
10.0								
10.5								
11.0								
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100.0								

*End of boring 8'*



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

**Well Drilling and Installation Log**

Site Name: <i>PM2-1.3042</i>	Boring #: <i>2</i>	Page: <i>1</i> of <i>1</i>
Location: <i>3000 Rte 100</i>	W.A.: <i></i>	Date Started: <i>12/1/84</i>
Town/State: <i>Waco, Texas</i>	Surface Elevation: <i></i>	Date Completed: <i>12/7/84</i>
Drilling Contractor: <i>Waco Drilling</i>	Sampler: <i>2" x 4" SPT</i>	
Drilling Equipment: <i>Waco Drilling</i>	Field Geologist: <i>J. E. Felt</i>	
Drilling Method: <i></i>	Driller: <i>Waco Drilling</i>	

Depth (Ft.)	Sample				Sample Description	OVA/ HNu (ppm)	COMMENTS
	#	Interval	Blows	Penetr/ Recov.	"N" Value		
0.0							
0.5							
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0	4-5			4/3			
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							
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*End of Boring 2*

*Sample  
B2 1.5-2' zone  
5'*



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

**Well Drilling and Installation Log**

Site Name: <i>Superfund Site</i> Location: <i>3000 S. 1st St.</i> Town/State: <i>Fla. 32101</i>	Boring #: <i>3-3</i> W.A.: Surface Elevation:	Page: of 1 Date Started: <i>12/1/94</i> Date Completed: <i>12/7/94</i>
Drilling Contractor: <i>Joe's Drilling</i> Drilling Equipment: <i>1" Drill</i> Drilling Method:	Sampler: <i>1" x 4' Split Sp.</i> Field Geologist: <i>J. J. [unclear]</i> Driller: <i>Joe's Drilling</i>	

Depth (Ft.)	Sample			Penetr/ Recov.	"N" Value	Sample Description	OVA/ HNu (ppm)	COMMENTS
	#	Interval	Blows					
0	1	0-4		4/1.2		5' interval top of 3" x 4' split sp.		Sample B3-1-2
0.5						5' interval 3" x 4' split sp.		
1.0						5' interval 3" x 4' split sp.		
1.5						5' interval 3" x 4' split sp.		
2.0						5' interval 3" x 4' split sp.		
2.5						5' interval 3" x 4' split sp.		
3.0						5' interval 3" x 4' split sp.		
4.0	2	4-8		4/3		36" total 5" core is shown		Sample B3-2-3
4.5						31" yellowish brown silt and		
5.0						fine sand some siltstone		
5.5						sub rounded dark gray silts		
6.0						present 10 TR 4/6		
6.5								
7.0								
7.5								End of Boring
8.0								
8.5								
9.0								
9.5								
10.0								
10.5								
11.0								
11.5								
12.0								



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

## Well Drilling and Installation Log

Site Name: <u>H-7000 # 2</u>	Boring #: <u>C-1</u>	Page 1 of 1
Location: <u>S. 2nd St. &amp; 1st Ave.</u>	W.A.: _____	Date Started: <u>12/1/94</u>
Town/State: <u>St. Paul, MN</u>	Surface Elevation: _____	Date Completed: <u>12/7/94</u>
Drilling Contractor: <u>USEPA/STC</u>	Sampler: <u>2" x 4' Split-Spoon</u>	
Drilling Equipment: <u>Handheld</u>	Field Geologist: <u>Joe Filas</u>	
Drilling Method: _____	Driller: <u>John M. [unclear]</u>	

[illegible]



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

**Well Drilling and Installation Log**

Site Name: <i>Location #2</i>	Boring #: <i>C-2</i>	Page of <i>1</i>
Location: <i>Butte Residence</i>	W.A.:	Date Started: <i>2/2/94</i>
Town/State: <i>Butte, MT</i>	Surface Elevation:	Date Completed: <i>2/7/94</i>
Drilling Contractor: <i>EXP/RLA</i>	Sampler: <i>2" x 4' SPT</i>	
Drilling Equipment: <i>Coleman</i>	Field Geologist: <i>J. E. Fournier</i>	
Drilling Method:	Driller: <i>F. J. Fournier</i>	

Depth (Ft.)	Sample			Penetr/ Recov.	*N* Value	Sample Description	OVA/ HNu (ppm)	COMMENTS
	#	Interval	Blows					
0	1	0-4		4/10		10' SPT to 5' Brown - 10' SPT 25' 5/8 - 10' SPT 25' 5/8 - 10' SPT 25' 5/8		
5								
10								
15								
20								
25								
30								
35								
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195								
200								

*end of Boring 4'*  
*Refuse at 4'*



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

## Well Drilling and Installation Log

Site Name: <u>                    </u>	Boring #: <u>          </u>	Page 1 of 1
Location: <u>                    </u>	W.A.: <u>                    </u>	Date Started: <u>          </u>
Town/State: <u>                    </u>	Surface Elevation: <u>          </u>	Date Completed: <u>          </u>
Drilling Contractor: <u>                    </u>	Sampler: <u>                    </u>	
Drilling Equipment: <u>                    </u>	Field Geologist: <u>                    </u>	
Drilling Method: <u>                    </u>	Driller: <u>                    </u>	

[illegible]



**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

**Well Drilling and Installation Log**

Site Name: <i>Hydrom #2</i>	Boring #: <i>121</i>	Page 1 of 1
Location: <i>near residence</i>	W.A.:	Date Started: <i>12/7/04</i>
Town/State: <i>LA, N.J.</i>	Surface Elevation:	Date Completed: <i>12/7/04</i>
Drilling Contractor: <i>ONECO/ALPC</i>	Sampler: <i>20243</i>	
Drilling Equipment: <i>Core, etc.</i>	Field Geologist: <i>W. F. 121</i>	
Drilling Method:	Driller: <i>B. and M. K. 121</i>	

Sample					Sample Description	OVA/ HNu (ppm)	COMMENTS
Depth (Ft.)	#	Interval	Blows	Penetr/ Recov.			
	1	0-4		4/21		35" sand 2" Brown coarse S&G 2.5" x 1/4" 3/8" coarse white sand 1" Brown 7.5" R 5/8" medium	Sample DI-2
0.5						5 1/2" sand, 1/4" gravel, fine to med frags	
1.0						1" x 1/2" fine to med sand + gravel	
1.5						Bottom 5" grades to yellowish	
2.0						Brown 10-12 1/2 S&G and R sand	
2.5						5.0" med gravel frags present	Sample DI-4
3.0						medium	
3.5						24" sand same as above - continuing	
4.0	2	4-8		4/22		above - continuing	
4.5						2nd interval ending	
5.0						Downward sequence for	
5.5						Gravel frags towards bottom	
6.0						of core	
6.5							
7.0							
7.5							end of Boring 8
8.0							
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**U.S. Environmental Protection Agency Environmental Response Team  
Response Engineering & Analytical Contract**

## Well Drilling and Installation Log

Site Name: <i>44444444</i>	Boring #: <i>D-2</i>	Page of <i>1</i>
Location: <i>Box 123456</i>	W.A.:	Date Started: <i>1/1/64</i>
Town/State: <i>Box 123456</i>	Surface Elevation:	Date Completed: <i>1/7/64</i>
Drilling Contractor: <i>Box 123456</i>	Sampler: <i>Box 123456</i>	
Drilling Equipment: <i>Box 123456</i>	Field Geologist: <i>Box 123456</i>	
Drilling Method:	Driller: <i>Box 123456</i>	

[illegible]



## **APPENDIX D**

### **USEPA ERT/REAC SPECTRACE 2000 XRF SOP**



**SPECTRACE 9000 FIELD PORTABLE X-RAY FLUORESCENCE  
OPERATING PROCEDURE**

**USEPA - SOP #1713**



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## 1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to serve as a guide to the start up, check out, operation, calibration, and routine use of the Spectrace 9000 instrument for field use in screening hazardous or potentially hazardous inorganics. It is not intended to replace or diminish the use of the Spectrace 9000 Operating Instructions. The Operating Instructions contain additional information for optimizing instrument performance and for utilizing its different applications.

The procedures contained herein are general operating procedures which may be changed as required, depending on site conditions, equipment limitations, limitations imposed by the Quality Assurance/Quality Control (QA/QC) procedure or other protocol limitations. In all instances, the procedures finally employed should be documented and included in any or all final reports.

### 1.1 Principles of Operation

X-Ray Fluorescence (XRF) Spectroscopy is a non-destructive qualitative and quantitative analytical technique used to determine the chemical composition of samples. In a source excited XRF analysis, primary X-rays emitted from a sealed radioisotope source are utilized to irradiate samples. During interaction of the source X-rays with samples, the source X-rays may either undergo scattering (dominating process) or absorption by sample atoms in a process known as the photoelectric effect. This most useful analytical phenomenon originates when incident radiation knocks out an electron from the innermost shell of an atom. The atom is excited and releases its surplus energy almost instantly by filling the created vacancy with an electron from one of the higher energy shells. This rearrangement of electrons is associated with the emission of X-rays characteristic (in terms of energy) of the given atom. This process is referred to as emission of fluorescent X-rays (fluorescent yield). The overall efficiency of the process described is referred to as excitation efficiency and is proportional to the product of the absorption coefficient and the fluorescent yield.

The Spectrace 9000 utilizes characteristic X-ray lines originating from the innermost shells of the atoms K, L and M. The characteristic X-ray lines of the K series are the most energetic lines for any element and, therefore, are the preferred analytical lines. The K lines are always accompanied by the L and M lines

of the same element. However, being of much lower energy than the K lines, they can usually be neglected for those elements for which the K lines are analytically useful. For heavy elements (such as cerium, atomic number (Z)=58, to uranium, Z=92), the L lines are the preferred lines for analysis. The  $L_{\alpha}$  and  $L_{\beta}$  lines have almost equal intensities, and the choice of one or the other depends on what interfering lines might be present. A source just energetic enough to excite the L lines will not excite the K lines of the same element. The M lines will appear together with the L lines.

The Spectrace 9000 Operating Instructions contain a table that identifies the X-rays (K or L) and elements measured for each excitation source.

An X-ray source can excite characteristic X-rays from an element only if the source energy is greater than the absorption edge energy for the particular line group (e.g., K absorption edge, L absorption edge, M absorption edge) of the element. The absorption edge energy is somewhat greater than the corresponding line energy. Actually, the K absorption edge energy is approximately the sum of the K, L, and M line energies, and the L absorption edge energy is approximately the sum of the L and M line energies of the particular element.

Energies of the characteristic fluorescent X-rays are converted (within the detector) into a train of electric pulses, the amplitudes of which are linearly proportional to the energy. An electronic multichannel analyzer (electronic unit) measures the pulse amplitudes, which is the basis of a qualitative X-ray analysis. The number of counts at a given energy is representative of element concentration in a sample and is the basis for quantitative analysis.

#### 1.1.1 Scattered X-rays

The source radiation is scattered from the sample by the physical process: coherent or elastic scattering (no energy loss), and Compton or inelastic scattering (small energy loss). Thus, the backscatter (background signal) actually consists of two components with X-ray lines close together. The higher energy line is equal to the source energy. Since the whole sample takes part in scattering, the scattered X-rays usually yield the most intense lines in the spectrum.



Since the scattered X-rays have the highest energies in the spectrum, they contribute most of the total measured intensity signal.

## 1.2 Sample Types

Solid and liquid samples can be analyzed for elements aluminum through uranium with proper X-ray source selection and instrument calibration. Typical environmental applications are:

- Heavy metals in soil (in situ or samples collected from the surface or from bore hole drillings, etc.), sludges, and liquids (e.g., lead in gasoline)
- Light elements in liquids (e.g., phosphorous, sulphur, and chlorine in organic solutions)
- Heavy metals in industrial waste stream effluents
- PCB in transformer oil by Cl analysis
- Heavy metal air particulates collected on membrane filters, either from personnel samplers or from high volume samplers
- Lead in paint.

## 2.0 METHOD SUMMARY

The Spectrace 9000 Portable XRF Analyzer employs the radioactive isotope sources iron-55, cadmium-109, and americium-241 for the production of primary X-rays. Each source emits a specific energy range of primary X-rays that cause a corresponding range of elements in a sample to produce fluorescent X-rays. When more than one source can excite the element of interest, the appropriate source(s) is selected according to its excitation efficiency for the element of interest. See page 1-2 of the Spectrace 9000 Operating Instructions for a chart of source types versus element range.

The sample is positioned in front of the source-detector window, and sample measurement is initiated which exposes the sample to primary radiation from the source. Fluorescent and backscattered X-rays from the sample enter through the beryllium detector window and are counted in the high resolution mercuric iodide (HgI<sub>2</sub>) detector.

Elemental concentrations are computed using a Fundamental Parameter (FP) algorithm of the form:

$$\text{Concentration} = R \times S \times (1 + \text{SUM}\{A_n \times C_n\})$$

"R" is the measured analyte X-ray intensity to the pure element; "S" is a calculated sensitivity coefficient. The quantity SUM{} is a summation of the "n"-element absorption-enhancement terms containing alpha-coefficients and iteratively computed element concentrations. The Spectrace 9000 utilizes FP XRF calibrations derived from theoretical considerations (as opposed to empirical data). The menu-driven software in the Spectrace 9000 supports multiple XRF calibrations called "Applications." Each Application is a complete analysis configuration including elements to be measured, interfering elements in the sample, and a set of FP calibration coefficients.

The measurement time of each source is user-selectable. The shorter source measurement times (15 - 30s) are generally used for initial screening and hot spot delineation, while longer measurement times (30 - 500s) are typically used for higher precision and accuracy requirements.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

This SOP specifically describes equipment operating procedures for the Spectrace 9000; hence, this section is not applicable to this SOP.

## 4.0 INTERFERENCE AND POTENTIAL PROBLEMS

The total method error for XRF analysis is defined as the square root of the sum of both instrument precision and user or application related error. Generally, the instrument



precision is the least significant source of error in XRF analysis. User or application related error is generally more significant and will vary with each site and method used. The components of the user or application related error are as follows:

#### 4.1 Sample Placement

This is a potential source of error because the X-ray signal decreases as the distance from the radioactive source is increased. However, this error is minimized by maintaining the same distance for each sample.

#### 4.2 Sample Representivity

This can be a major source of error if the sample does not represent the site. Representivity is affected by the soil macro- and micro-heterogeneity. For example, a site contaminated with pieces of slag dumped by a smelting operation will be more heterogenous than a site contaminated by liquid plating waste. This error can be minimized by either mixing a large volume of sample prior to analyzing an aliquot, or by analyzing several locations (in situ) at each sampling point and averaging the results.

#### 4.3 Reference Analysis

Soil chemical and physical matrix effects may be corrected by using Inductively-Coupled Plasma (ICP) or Atomic Absorption (AA) spectroscopy analyzed site-specific soil samples as calibration samples. A major source of error can result if the samples analyzed are not representative of the site and/or if the analytical error is large. Additionally, when comparing XRF results with reference analysis results, the efficiency of the sample digestion reference analysis should be considered. Some digestion methods may breakdown different sample matrices more efficiently than others.

#### 4.4 Chemical Matrix Effects (Due to the Chemical Composition of the Sample)

Chemical matrix effects result from differences in concentrations of interfering elements. These effects appear as either spectral interferences (peak overlaps) or X-ray absorption/enhancement phenomena. Both effects are common in soils contaminated with heavy metals, eg., iron tends to absorb copper X-rays, reducing the intensity of Cu measured by the detector. This effect can be corrected mathematically

through the use of FP coefficients.

#### 4.5 Physical Matrix Effects (Due to Sample Morphology)

Physical matrix effects are the result of variations in the physical character of the sample. They include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, consider a sample in which the analyte exists in the form of very fine particles within a matrix composed of much coarser material. If two separate aliquots of the sample are prepared in such a way that the matrix particles in one are much larger than in the other, then the relative volume of analyte occupied by the analyte-containing particles will be different in each. When measured, a larger amount of the analyte will be exposed to the source X-rays in the sample containing finer matrix particles; this results in a higher intensity reading for that sample and, consequently, an apparently higher measured concentration for that element.

#### 4.6 Application Error

Generally, the error in the application calibration is insignificant (relative to the other sources of error) IF the instrument's application operating instructions are followed correctly. However, if the sample matrix varies significantly from the design of the application (e.g., using the soil's application to analyze 50% iron mine tailing sample) the application error may become significant.

#### 4.7 Moisture Content

Sample moisture content will affect the analytical accuracy of soils or sludges. The overall error may be secondary when the moisture range is small (5-20%), or it may be a major source of error when measuring the surface of soils that are saturated with water.

#### 4.8 Cases of severe X-ray Spectrum Overlaps

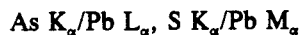
When present in the sample, certain X-ray lines from different elements can be very close in energy, and therefore, interfere by producing a severely overlapped spectrum.

The typical spectral overlaps are caused by the  $K_\alpha$  line of element Z-1 (or as with heavier elements, Z-2



or Z-3) overlapping with the  $K_{\alpha}$  line of the Z element. This is the so-called  $K_{\alpha}/K_{\beta}$  interference. Since the  $K_{\alpha}/K_{\beta}$  intensity ratio for the given element usually varies from 5:1 to 7:1, the interfering element, Z-1, must be present in large concentrations in order to disturb the measurement of analyte Z. The presence of large concentrations of vanadium (V) could disturb the measurement of chromium (Cr). The V  $K_{\alpha}$  and  $K_{\beta}$  energy is 5.41 keV. The resolution of the detector is approximately 270 eV. Therefore, large amounts of V in a sample will result in spectral overlap of the V  $K_{\beta}$  with the Cr  $K_{\alpha}$  peak. The Spectrace 9000 uses overlap factors to correct for  $K_{\alpha}/K_{\beta}$  spectral overlaps for the elements of interest for a given application.

Other interferences are K/L, K/M, and L/M. While these are less common, the following are examples of a severe overlap:



In the arsenic (As)/lead case, Pb can be measured from the Pb  $L_{\beta}$  line, and arsenic from either the As  $K_{\alpha}$  or the  $K_{\beta}$  line; this way the unwanted interference can be corrected. However, due to the limits of mathematical corrections, measurement sensitivity is reduced. Generally, As concentrations in samples with Pb:As ratios of 10:1 or more can not be efficiently calculated. This may result in zero As being reported regardless of what the actual As concentration is.

## 5.0 EQUIPMENT/APPARATUS

### 5.1 Description of the Spectrace 9000 System

The analyzer utilizes the method of Energy Dispersive XRF (EDXRF) spectrometry to determine the elemental composition of soils, sludges, aqueous solutions, oils, and other waste materials.

The Spectrace 9000 analyzer includes three, compact, sealed, radiation sources contained in a measuring probe. The three excitation sources provided are Fe-55, Cd-109 and Am-241. The analyzer software automatically selects which sources to use and the measurement time for each source based on stored information for each application. The probe is equipped with a high resolution  $\text{HgI}_2$  detector. This probe is connected by cable to an environmentally sealed electronic module.

The electronic unit provides internal non-volatile memory for storage of 120 spectra and 300 multi-element analytical reports. An RS-232 serial port is provided for downloading data and spectra to a peripheral device. The multi-element analytical reports and the 2000-channel spectra can be displayed on the instrument's LCD panel. The replaceable and rechargeable internal battery provides for field-portable operation.

The Spectrace 9000 is supplied with three factory-installed FP-based applications (calibrations). A "Soil Samples" application is provided for analysis of soils where the balance of the sample, or that portion not directly measured by the instrument, is silica ( $\text{SiO}_2$ ). A "Thin Film" application is provided for analysis of thin films such as air monitoring filters or wipes. A "PbK in Paint" application is provided for analysis of Pb in paint and is reasonably independent of the type of substrate. Additionally, Spectrace will develop calibrations to meet new user applications (e.g., adding elements to the present "Soil Samples" application).

The Spectrace 9000 can be powered from a 115-volt (or 220-volt) wall outlet or from its four-hour capacity battery. It can be operated in temperatures ranging from 32 to 120°F.

The probe and electronic unit may be exposed to a light rain. However, additional protection is provided when the system (electronic unit and probe) is contained in the optional water repellant carrying case.

### 5.2 Equipment and Apparatus List

#### 5.2.1 Spectrace 9000 analyzer System

The complete Spectrace 9000 Analyzer System includes:

- Analyzer unit for data acquisition, processing and display
- Hand-held probe including:
  1. High-resolution  $\text{HgI}_2$  detector



2. Three excitation sources ( $^{55}\text{Fe}$ ,  $^{109}\text{Cd}$ ,  $^{241}\text{Am}$ )

Personal  
Computer (PC)

3. Safety cover

- Spare probe window assembly

• Probe laboratory stand with the following:

1. Base for table top use
2. Safety shield over sample
3. Positioning fixtures for standard 30mm and 40mm X-ray sample cups
4. Interconnecting cable
5. RS-232C Interface cable
6. Two blank check samples
7. Pure element check samples
8. Battery charger
9. Battery pack
10. System carrying/shipping case

Spare battery pack, charger and charger adaptor (required to charge spare battery outside of data unit)

See the Spectrace 9000 Accessories Price List for additional options.

For mobile lab or laboratory X-ray sample preparation accessories, such as drying ovens, grinders, sieves, etc., consult general laboratory equipment suppliers.

### 5.2.3 Limits and Precautions

The probes should be handled in accordance with the following radiological control practices:

1. The probe should always be in contact with the surface of the material being analyzed and the analyzed material should completely cover the probe opening (aperture) when the source is exposed. Do not remove a sample or move the probe while the indicator shows **SOURCE ON**.

**SOURCE ON** indicators are:

- a. the message on the screen "SOURCE ON"
- b. the flashing light at the base of the probe.

Spectrace 9000 Operating Instructions, application software and utilities software. The application software is specific to each unit and cannot be interchanged between different units. The software is identified by the serial number of the unit.

### 5.2.2 Optional items

- 31-mm diameter sample cups
- X R F polypropylene film, 0.2 mil thick
- Field carrying case
- Peripheral devices such as a printer or IBM compatible

2. When the sources are exposed, under no circumstances should the probe be pointed at the operator or surrounding personnel.
3. Do not place any part of the operator's or co-worker's body in line of exposure when the sources are exposed or partially covered.



4. The probe must be covered with the safety cover or laboratory safety shield when not in use.
5. Spectrace Instruments must be notified immediately of any condition or concern relative to the probe's structural integrity, source shielding, source switching condition, or operability.
6. The appropriate state agency or the Nuclear Regulatory Commission (NRC) office must be notified (see factory supplied data on radiological safety) immediately of any damage to the radioactive source, or any loss or theft of the device.
7. Labels or instructions on the probe(s) must not be altered or removed.
8. The user must not attempt to open the probe.
9. The source(s) in the probe must be leak tested every six months as described in the Spectrace 9000 Operating Instructions. The leak test Certificates must be kept on file, and a copy must accompany the instrument at all times.
10. The probe laboratory safety shield assembly must be used when the probe is inverted for measuring samples contained in cups.
11. During operation, the probe must be kept at least 10 feet from computer monitors and any other source of radio frequency (RF). Some monitors have very poor RF shielding and will affect measurement results.
12. The Spectrace 9000 should not be dropped or exposed to conditions of excessive shock or vibration.

#### Additional precautions include:

1. The probe cable must never be pulled while unplugging the probe. The probe plug should be grasped at the ribbed metal connector and squeezed and pulled gently while unplugging the connector. The connector must never be forced when plugging in the connector.
2. The handle of the electronic unit must not be rotated unless the release buttons on each side of the handle are depressed.
3. The Spectrace 9000 should not be stored at an ambient temperature below -4°F or above 110°F.
4. The battery charging unit should only be used indoors in dry conditions.
5. Battery packs should be changed only in dry conditions.

### 5.3 Peripheral Devices

The Spectrace 9000 may be used with a wide range of peripheral devices for electronic data capture or printed readout as long as they are compatible with the RS-232 serial I/O protocol. Such devices include terminals, printers, electronic data loggers, PCs, etc.

#### 5.3.1 Communication Cable Connection

Plug the 25-pin connector of the RS-232 Serial I/O cable into the Spectrace 9000 25-pin D connector (the connector just below the display screen on the electronic unit) and the 9-pin connector of the cable into the serial port of the receiving device.

#### 5.3.2 Communication Port Setup

To communicate with an external device, the Spectrace 9000 MUST be set at the same baud rate, word length, and parity as the receiving device. The Spectrace 9000 allows you to select various configurations for these parameters in the communication



(Comm.) port setup portion of the More submenu (accessed from the main menu). The default COM setup for application and utilities software is 9600, N,8,1.

### 5.3.3 User Software

Refer to your PC software manual for details on additional settings that may be required for proper interfacing between the Spectrace 9000 and your particular software.

## 5.4 Instrument Maintenance

### 5.4.1 Probe Window

Should the probe window become damaged or punctured, it should be replaced as soon as possible to prevent dust and moisture from entering the probe. Replacement window assemblies can be ordered from Spectrace Instruments. Note the location of the window aperture; it is closer to one end of the window plate. Simply unscrew the old window plate, press any corner of it and remove. Stretch the O-ring for 10 seconds, and lay it back in the groove. The O-ring must lie flat in the groove in order for the new window plate to be installed. Install the new window assembly in the same orientation as the old. If the surface of the window plate is not flush with the face of the probe, the O-ring has probably come out of the groove. Remove the assembly, and try the same procedure again.

### 5.4.2 Further Information and Troubleshooting

Refer to the Spectrace 9000 Operating Instructions for additional detailed operation and/or maintenance and troubleshooting instructions. If no solution is found in the manual, contact Spectrace Instruments for assistance.

An instrument log should be maintained to document specific corrective actions taken to alleviate any instrument problems, or for recording any service that has been performed.

## 6.0 REAGENTS

Generally, calibration standards are not necessary for site screening and extent of contamination analyses. Optionally, an application (only the Soil Sample application will be discussed here) can be optimized or verified to be 1:1 proportional to another analytical (reference) method. This can be done by analyzing a set of Site-Specific Calibration Standards (SSCS) and performing a regression analysis on the reference (dependent) and the Spectrace 9000 results (independent) for each element of concern. In an application, any element's calibration can be adjusted by entering the desired slope and offset (intercept) in the Adjust Calibration menu. If any element's calibration has been adjusted in an application, "adj" will appear on the results screen. An adjusted element calibration can be changed back to the initial slope and offset values of 1 and 0, respectively, in the application.

### 6.1 Site-Specific Calibration Standards (SSCS)

SSCS must be representative of the matrix to be analyzed by XRF. The concentration of the target elements in the SSCS should be determined by independent AA or ICP analyses that meet quality levels for referee data.

#### 6.1.1 SSCS Sampling

See section 4.2 on sample representivity. The SSCS samples must be representative of the matrix to be analyzed by XRF. It does not make sense to collect SSCS samples in the site containment area if you are interested in investigating off-site contamination migration. The matrices may be different and could affect the accuracy of the XRF results. If there are two different matrices on site, collect two sets of SSCS samples.

A full range of target element concentrations is needed to provide a representative calibration curve. Mixing high and low concentration soils to provide a full range of target element concentrations is not recommended due to heterogeneity problems. Unlike liquid samples, solid samples cannot be diluted and re-analyzed.

Additionally, collect several SSCS samples in the concentration range of interest. If the



action level of the site is 500 mg/kg, providing several SSCS samples will tend to improve the XRF analytical accuracy in this concentration range.

Generally, a minimum of seven appropriate SSCS samples should be taken. A minimum sample size of 4 oz. is recommended. A larger size sample should be taken to compensate for sites with greater content of non-representative materials such as rocks and/or organic debris. Standard glass sampling jars should be used.

### 6.1.2 SSCS Preparation

The SSCS samples should be either air dried overnight, or oven dried at less than 105°C. Aluminum drying pans of large plastic weighing boats for air drying may be used. After drying, remove all large organic debris and non-representative material (twigs, leaves, roots, insects, asphalt, rocks, etc.).

The sample should be sieved through a 10-mesh stainless steel sieve. Clumps of soil and sludge should be broken up against the sieve using a stainless steel spoon. Pebbles and organic matter remaining in the sieve should be discarded. The under-sieve fraction of the material constitutes the sample.

Although the maximum final particle size of 10-mesh is normally recommended, a smaller particle size may be desired. The sample should be mixed by dividing the sieved soil into quarters and physically mixing opposite quarters with a clean stainless steel spoon. Re-combine and repeat the quartering and mixing procedure three times. Place the sieved sample in a clean sample jar and label it with both the site name and sample identification information.

The stainless Steel sieves should be decontaminated using soap and water. They should be dried between samples.

One or more plastic XRF sample cups should be filled with the sieved soil for each SSCS sample. A piece of 0.2-mil polypropylene film should be cut and stretched over the top of the X-ray sample cup until the film is wrinkle-free, then sealed using the plastic securing ring. The cup should be labeled using both the site name and specimen identification information.

Either the XRF sample cup or the balance of the prepared sample, is submitted to the approved laboratory for analysis of the requested element(s) by AA or ICP.

## 7.0 PROCEDURE

### 7.1 Prerequisites

If the Spectrace 9000 will be used in a location where AC power outlets are conveniently accessible, connect the battery charger to the electronic unit and plug the charger cord into the outlet. The probe cable must be connected before the power is switched on. Plugging and unplugging this cable with the power on can damage the detector.

To connect the battery, set the electronics unit on its face and use a flat blade screwdriver to loosen the two one-quarter turn fasteners on the back. Remove the battery pack. Inside, find the cord with the red cap covering the three-pronged plug. Remove the cap and plug it into the battery pack. Put the battery pack into the unit and tighten the fasteners.

Apply power to the Spectrace 9000 by pressing the <ON> button. The electronic unit may not come on with the battery charger hooked up if the battery has been totally drained. The drained battery may require a 10 minute charge prior to start up. In a few seconds, the display shows the version of software. If necessary, adjust the contrast knob located on the underside of the front display. This knob can be turned so far that the display appears blank.

The initial screen displays for about 10 seconds and then a prompt will ask if the time and date are set correctly. The date MUST be set correctly, otherwise serious errors in the source-decay compensation can result. Additionally, the results



tables include the time and date of analysis. The main menu appears after the time and date screen.

If a "battery low" message appears, recharge the battery before proceeding, or operate the unit using line voltage.

Allow the Spectrace 9000 to warm up for approximately 30 minutes after it has been turned on, before performing analysis.

### 7.1.1 Gain Control

Automatic gain compensation is a feature of both Soil and Thin Samples applications that allow operation of the instrument over a wide range of ambient temperatures and from one day to another without standardization. To maintain this gain control compensation, it is necessary to operate it occasionally with a minimum acquisition time of 50 seconds on the Cd-109 source. If the automatic gain control fails or is out of range, an error message will appear on the screen. If the error message continues to appear after repeat analyses, then the Cd-109 measurement time should be checked and/or an energy calibration should be performed. If the problem continues, contact Spectrace Instruments for help.

### 7.1.2 Setting Data and Spectrum Store/Send Mode

The *Set store/send modes* option is located in the More screen of the main menu. Data and/or Spectrum storage must be enabled for automatic on-board storing to occur. Sufficient memory is available to store up to 300 sets of analytical results and up to 120 spectra (spectra for 40 samples since each sample has three spectra). When the available spectra or results memory is full, the spectra or results storage mode is disabled. The filled spectra or results memory must be cleared (deleted) and the respective store mode enabled before results and/or spectra will be stored again.

## 7.2 General Keys and Menu Software

This section outlines the general keys and basic menu software. Flow charts which describe the menu structure in detail are located in pages 4-13 through 4-17 of the Spectrace 9000 Operating Instructions.

### 7.2.1 The Keyboard

The row of numeric keys under the LCD screen performs functions defined by labels that the software writes (a menu) to the bottom line of the display. As you move through the various menus, the keys are redefined to provide an efficient user interface.

The keypad to the right of the screen is used for numeric entry. The <CONT/PAUSE> key (referred to as the <CONT>) is used:

- to enter information as an <ENTER> key
- to begin an analysis
- to pause an analysis in progress

The <-> (left arrow) key is used to edit entries before pressing <CONT>.

### 7.2.2 The Measure (Ready) Screen

This main menu selection displays the application name, revision date and count times for each of the three sources, and accesses other options (see flow diagrams in the Spectrace 9000 Operating Instructions).

### 7.2.3 The Choose an Application Screen

This main menu selection lists the applications currently loaded in the unit. Applications are selected and source measurement times may be modified in this screen (see flow diagrams in the Spectrace 9000 Operating Instructions).



### 7.2.4 The Review Stored Results Screen

This main menu selection lists the stored results. *Up* and *Down* scroll are used on many screens. When *Up* and *Down* are displayed, pressing the <0> (zero) key will toggle to *PgUP* and *PgDN* for rapid movement through long lists. Stored results may be reviewed, deleted or sent out the COM port (see flow diagrams in the Spectrace 9000 Operating Instructions).

### 7.2.5 The Review Stored Spectra Screen

This menu selection lists the stored spectra which may be deleted or transmitted to the COM port (see flow diagrams in the Spectrace 9000 Operating Instructions). You cannot review spectra under this screen. Spectra may be reviewed in the *Examine Spectrum* portion of the Results screen under the *More Options* menu selection.

### 7.2.6 The More (Other Functions) Screen

This main menu selection lists the following functions:

- *Set clock/calendar*
- *Comm. port setup*
- *Set store/send modes*
- *Application maintenance*
- *Examine spectrum*

### 7.2.7 The Results Screen

At the end of the analysis, the Results screen is displayed. If the automatic *Store Results* mode is enabled, you will be prompted for sample identification (*ID*) before the results screen is displayed. *UP* or *DOWN* scrolls the screen to see more results. When *UP* and *DOWN* are displayed, pressing the <0> key will toggle to *PgUP* and *PgDN* for rapid movement through long lists. *Send* transmits the results report to the COM port. *Store* prompts you to enter an *ID* and then stores the results in the memory. *Measr* will immediately begin another analysis

cycle. *Optis* will bring up the first of two screens (the second screen is located under *More Optis* of the first screen) of special options under the Results screen (see flow diagrams in the Spectrace 9000 Operating Instructions). The most frequently used functions are the *Examine Spectrum* and *Enable/Disable Display Thresholds* located on the second screen of the options.

## 7.3 Pre-operational Checks

### 7.3.1 Energy Calibration Checks

The Energy calibration check is performed daily in the field to verify proper energy calibration. To do this, place the safety cover on the probe. Select the Soil Samples application and measure the safety shield using a minimum acquisition time of 60 seconds for each source. Save the results and spectra for documentation. Select *Examine Spectrum* under the *More Options* selection of the Results screen. Examine the spectrum of each source. Locate and record the centroid KeV (using the x12 horizontal magnification) for each of the following peaks:

Source Peak	Theoretical (KeV)	Specification (KeV)
Cd-109	Pb L-alpha	10.54
	Pb L-beta	12.61
	Pb L-gamma	14.76
	Emission peak	22.10
Fe-55	S K-alpha	2.31
	Emission peak	5.89
Am-241	Pb L-alpha	10.54
	Pb L-beta	12.61
	Pb L-gamma	59.5

Perform an *Energy calibration* (see Spectrace 9000 Operating Instructions) and then do another if any of the peaks fail to meet specification. The energy calibration check should be performed once at the beginning of the day, after an energy calibration, after loading an application, and whenever the instrument exhibits a persistent drift.



### 7.3.2 Resolution Check

The resolution check examines the detector's ability to resolve X-ray energies. This should be performed once at the beginning of the day. Select the Soil Samples application, and measure a sample of iron using a minimum acquisition time of 60 seconds for the Cd-109 source. Save the results and spectra for documentation. Select *Examine spectrum* under the More Options screen of the Results screen. Examine the Cd-109 spectrum. Locate and record the maximum peak counts (must be > 1000 counts) of the iron K-alpha peak (6.4 KeV) using the x12 horizontal magnification. Divide the maximum peak counts by two. Examine the right side of the peak and record the counts an KeV of the channel just above one-half the maximum peak count value. Examine the left side of the peak and record the counts and KeV of the channel just below one-half the maximum peak count value. Subtract the left-side KeV from the right-side KeV. The difference should be less than 0.300 KeV. If the unit fails to meet this specification, call Spectrace Instruments for assistance.

### 7.3.3 Blank (Zero) Sample Check

The blank (Zero) sample check is performed to monitor the instrument's zero drift. This should be done once at the beginning of the day, after an energy calibration, after loading an application, and whenever the instrument exhibits a persistent drift on a blank or low level sample.

Mount the probe in the laboratory stand and select the Soil Samples application. Disable the display thresholds. This will permit results less than one standard deviation (STD) to be displayed (even negatives). Measure the Teflon™ blank provided with the unit using a minimum acquisition time of 60 seconds for each source. Review the results table. Most (95%) of the elemental results should be  $0 \pm (2 \times \text{STD})$  (their respective standard deviation), and all of them (99%) should be  $0 \pm (3 \times \text{STD})$  (their respective standard deviation). Repeat the

measurement if the unit fails to meet these specifications. If several elements continue to be significantly outside of these specifications, check the probe window and the blank sample for contamination or perform the *Acquire background data* operation located in the Measure (Ready) screen option. Perform the blank (Zero) sample check again. Save the results and spectra for documentation. Enable the display thresholds prior to sample analysis after the blank check procedure is completed.

### 7.3.4 Target Element Response Check

The purpose of the target element response check is to ensure that the instrument and the selected application are working properly prior to performing sample analysis. This check should be performed at the beginning of the day. Use low, mid, and high samples, or standards with known concentrations for some or all of the target elements to be checked. Select a low sample near the quantitation limit of the target elements. Select a mid sample near the site action level and a high sample near the maximum concentration of the target elements expected on site.

These samples should be measured using the same source acquisition times that will be used for sample analysis. Save the sample check results and spectra for documentation.

## 7.4 Selecting Source Measuring Time

The source measuring time may be modified under the Measure screen. Zero (seconds) should never be selected for any application. Generally, for source measurements up to 1000 seconds, the element detection limit will be reduced by 50% for every four-fold (x4) increase in source measuring time. The elements are grouped together according to the radioisotope used for their excitation with typical minimum detection limits shown in Sections 7.4.2 and 7.4.3.

Automatic gain compensation is a feature of both the Soil and Thin Samples applications which allows operation of the instrument over a wide range of ambient temperatures and from one day to another



without standardization. To maintain this gain control compensation, it is necessary, occasionally, to operate with a minimum acquisition time of 50 seconds on the Cd-109 source.

The *Real/live* option toggles between real time (true clock time) and live time (total time the instrument is counting). The latter adds time to the analysis to make up for the time the system is busy processing pulses.

#### 7.4.1 Minimum Source Measuring Times

A minimum measuring time (real or live) of 20 seconds for the Fe-55 source, 30 seconds for the Cd-109 source, and 10 seconds for the Am-241 source is recommended when using the Soil Samples application. Measuring times for a source that excites a target element can be increased if lower detection limits are required.

When using the Thin Samples application, the measuring time for any source may be reduced to 10 seconds if the source does not excite a target element since this application does not correct for interelement effects. If a source excites a target element, a minimum measuring time (real or live) of 60 seconds for the Fe-55 source, 60 seconds for the Cd-109 source, and 120 seconds for the Am-241 source is recommended.

A minimum of 60 seconds is recommended for the Cd-109 source when using the PbK in Paint application.

#### 7.4.2 Typical Minimum Detection Limits (MDLs) for the Soil Samples Application

For source measuring times of 60 seconds, the typical element milligram per kilogram (mg/kg) MDLs for the Soil Samples application are:

Source	Element	ug/cm <sup>2</sup>
Fe-55	Potassium (K)	325
	Calcium (Ca)	150
	Titanium (Ti)	110
Cd-109	Chromium (CrLo)	180
	Chromium (CrHi)	525
	Manganese (Mn)	410
	Iron (Fe)	225
	Cobalt (Co)	205
	Nickel (Ni)	125
	Copper (Cu)	90
	Zinc (Zn)	70
	Mercury (Hg)	60
	Arsenic (As)	50
	Selenium (Se)	35
	Lead (Pb)	30
	Rubidium (Rb)	10
	Strontium (Sr)	10
	Zirconium (Zr)	10
Am-241	Molybdenum (Mo)	10
	Cadmium (Cd)	180
	Tin (Sn)	100
	Antimony (Sb)	65
	Barium (Ba)	20

Generally, for source measurements up to 1000 seconds, the element detection limit will be reduced by 50% for every four-fold (x4) increase in source measuring time. Additionally, more elements may be added to the Soil Samples application. Contact Spectrace Instruments for information about modifications to applications.

#### 7.4.3 Typical Minimum Detection Limits (MDLs) for the Thin Samples Application

For source measuring times of 200 seconds for the Fe-55 and Cd-109 sources, and 800 seconds for the Am-241 source, the typical element microgram per square centimeter (ug/cm<sup>2</sup>) MDLs for the Thin Samples application are:

Source	Element	ug/cm <sup>2</sup>
Fe-55	Potassium (K)	325
	Calcium (Ca)	150
	Titanium (Ti)	110



Source	Element	ug/cm <sup>2</sup>
Cd-109	Chromium (CrLo)	180
	Chromium (CrHi)	525
	Manganese (Mn)	410
	Iron (Fe)	225
	Cobalt (Co)	205
	Nickel (Ni)	125
	Copper (Cu)	90
	Zinc (Zn)	70
	Mercury (Hg)	60
	Arsenic (As)	50
	Selenium (Se)	35
	Lead (Pb)	30
	Rubidium (Rb)	10
	Strontium (Sr)	10
	Zirconium (Zr)	10
	Molybdenum (Mo)	10
Am-241	Cadmium (Cd)	180
	Tin (Sn)	100
	Antimony (Sb)	65
	Barium (Ba)	20

Generally, for source measurements up to 1000 seconds, the element detection limit will be reduced by 50% for every four-fold (x4) increase in source measuring time. Use of thick filters, filters with high background or contamination will result in higher MDLs and require a background subtraction. Additionally, more elements may be added to the Thin Samples application. Contact Spectrace Instruments for information about modifications to applications.

## 7.5 Sample Handling and Presentation

When making XRF measurements, be sure to maintain constant measurement geometry in order to minimize variations in analysis results. Document any anomalies in measurement geometry, sample surface morphology, moisture content, sample grain size, and matrix (see Section 4.0).

### 7.5.1 Soil Samples

Soil samples may be analyzed either in situ or in prepared X-ray sample cups. The Soil Samples application assumes the sample to be infinitely thick. For in situ measurements this is almost always the case,

but, for sample cup measurements it is advisable to fill the cup nearly full and tap it on the bench to compact the soil. This ensures that the sample is as uniformly thick as possible from sample to sample. The Spectrace 9000 laboratory stand and safety shield should be used when analyzing sample cups.

An area for in situ analysis should be prepared by removing large rocks and debris. The soil surface should be rendered flat and compact prior to analysis. The Spectrace 9000 probe should be held firmly on the ground to maximize instrument contact with the ground. The probe should not be moved during analysis. Analysis of water saturated soils should be avoided. A layer of 0.2-mil polypropylene XRF film may be mounted on the surface probe to minimize contamination. Use of varying thicknesses of plastic (bags) have been shown to interfere in the light element measurement and may affect the FP calibration of the other element concentrations. Additionally, plastic may contain significant levels of target element contamination.

Coarse-grained soils conditions or nuggets of contaminated material may not permit a truly representative sample and may adversely affect the analysis results (typically by under reporting the target element). Such samples should be prepared before analysis. Preparation consistency is important to minimize variation in analytical results.

This application is specifically designed for soil with the assumption that the balance of the material is silica. If samples with a much lighter balance are analyzed, the results will typically be elevated by a factor of two to four. Contact Spectrace Instruments for help in analysis of different matrices.



### 7.5.2 Thin (Filter) Samples

The Thin Samples application is for analysis of thin samples such as filters or wipes. The detection limits are affected by the thickness of the substrate. Best results are obtained on the thinnest substrates. Always use the probe safety cover when measuring thin samples. This is not only for user safety, it also ensures a controlled background environment and provides a reference signal for the automatic gain control. Probe safety covers should never be interchanged between instruments.

Filters and wipes should be prescreened before use. This will establish the background and contamination levels of the filters or wipes. Care should be used to prevent zinc oxide contamination from disposable gloves. Small 37-mm filters can be mounted between two layers of 0.2-mil thick polypropylene XRF film on 40-mm XRF cups for analysis. Larger filters can be placed on the probe with a sheet of 0.2-mil thick polypropylene XRF film between the filter and probe to prevent the window from being contaminated. Then the probe safety cover may be placed over the filter prior to analysis. Filters should be presented loaded side down and wrinkle free.

### 7.5.3 Lead in Paint

The area selected for analysis should be smooth and representative. The Spectrace 9000 probe should be firmly on the surface to maximize instrument contact. The probe should not be moved during analysis.

When used for specimen application, e.g., on paint chips or non-backed films, remember to use the probe safety cover. In the PbK Application, you should also position a thick neutral sample, such as the quartz disk (blank), behind the specimen before closing the safety lid. Otherwise, the PbK X-rays excited in the safety cover will be sensed by the detector. In this application, do not perform the *Acquire background data* option from the list of options under the Ready screen.

## 8.0 CALCULATIONS

The Spectrace 9000 is a direct readout instrument that does not require any calculations.

## 9.0 QUALITY ASSURANCE/QUALITY CONTROL

### 9.1 Precision

The precision of the method is monitored by reading the low or mid SSCS selected as described in Section 6.1 at the start and end of sample analysis and after approximately every tenth sample (a daily total of seven measurements is recommended). Determining the precision around the site action level can be extremely important if the XRF results are to be used in an enforcement action. Therefore, selection of an SSCS at or near the site action level or level of concern is recommended. The sample is analyzed by the instrument for the normal field analysis time, and the results are recorded. The standard deviation for each dependent element is calculated. The relative standard deviation (RSD) of the sample mean can be used to calculate precision. The RSD should be within  $\pm 20\%$  for the data to be considered adequately precise.

### 9.1.1 Preliminary Detection Limit (DL) and Quantitation Limit (QL)

A preliminary DL and QL is needed to give the operator an indication of the instrument's capability in the field. A low or blank SSCS sample is selected as described in Section 6.1. More than one standard may be needed to obtain low or blank concentration values for each element. Alternatively, the Teflon™ blank may be used if a blank soil sediment sample is unavailable. Disable the display thresholds to permit display of low or negative results.

The sample is measured ten times, without moving it, using the anticipated field analysis measuring time. The standard deviation of the mean for each target element is calculated (using the N-1 formula).

If the standard deviation has a fractional component, round up to the next whole number prior to calculating the DL and QL.



The definition of the DL is three times the calculated standard deviation value.

The definition of the QL is 10 times the calculated standard deviation value.

#### 9.1.2 The Method Minimum Detection Limit (MMDL) and Method Quantitation Limit (MQL)

The MMDL and MQL may be calculated from the measurement of either a low or blank SSCS, selected as described in Section 6.1, at the start and end of sample analysis, and after approximately every tenth sample (a daily total of seven measurements is recommended).

Disable the display thresholds. This will permit results less than one standard deviation (STD) to be displayed (even negatives). Measure the SSCS using the same analysis, measuring time used for the samples. Enable the display thresholds prior to analyzing the next sample.

The standard deviation of the mean for each target element is calculated. If the standard deviation has a fractional component, round up to the next whole number prior to calculating the MMDL and MQL.

The definition of the MMDL is three times the calculated standard deviation value.

The definition of the MQL is 10 times the calculated standard deviation value.

## 9.2 Reporting Results

All raw XRF data should be reported including the individual results of multiple analyses of samples and sampling points. The average and concentration range of each analysis should also be reported.

A "reported" value for each analysis or average of multiple analyses should be processed in the following manner.

1. Round the value to the same degree of significance contained in the

SSCS sample assay value (usually two) if the element's calibration has been adjusted (see Section 6.0).

2. Report all values less than or equal to the MMDL as not detected (ND).
3. Flag and note all values greater than the MMDL and less than or equal to the MQL (usually with a "J" next to the reported value).
4. Report all values above the MQL and within the linear calibration range [if the element's calibration has been adjusted (see Section 6.0)].
5. Flag and note all values above the linear calibration range (greater than the highest SSCS used in the calibration adjustment procedure) with a "\*" next to the reported value.

## 9.3 Accuracy

Accuracy, relative to a specific digestion method and elemental analysis procedure, is determined by sending an XRF analyzed sample (prepared sample cups may be submitted) out for AA or ICP analysis at a laboratory.

To do a total accuracy check, confirmation samples should be collected throughout the entire sampling effort. A minimum of 10% of the samples should be collected including a number of samples at or near the critical level. The results of the metal analysis (dependent) and the XRF analysis (independent) are evaluated with a regression analysis. The correlation coefficient ( $R^2$ ) should be 0.7 or greater. All XRF results are multiplied by the slope prior to substitution for metal analysis results in contouring, kriging programs, or removal volume estimates.

Another very important source of potential difference between XRF and AA or ICP results is incomplete digestion of the leaching technique. Since XRF is a total elemental technique, any comparison with referee results must account for the possibility of variable extraction depending upon the extraction



method used and its ability to dissolve the mineral form in question.

### 9.3.1 Matrix Considerations

Other types of QA/QC verification should include verification that the instrument calibration is appropriate for the specific site to be assessed. This includes verification of potential multiple soil matrix types that may exist at a site. Matrix variations that affect the XRF measurement include large variations in calcium content, such as may be encountered when going from siliceous to calcareous soils, as well as variations in iron content.

with the programs for details on their operation.

Alternatively, other software with terminal data logging capabilities may be used to capture results and spectra to disk files.

After capturing results to a file, print a copy and save both the disk files and the printout for future reference and documentation purposes.

## 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow USEPA, OSHA, corporate and/or any other applicable health and safety practices.

## 10.0 DATA VALIDATION

### 10.1 Confirmation Samples

Confirmation samples are recommended at a minimum rate of 10%. Confirmation samples are required if QA2 data objectives have been established for site activities. Ideally, the sample cup that was analyzed by XRF should be the same sample that is sent for AA/ICP analysis. When confirming an in situ analysis, collect a sample from a 6 inch by 6 inch area for both an XRF measurement and confirmation analysis.

The XRF and metals results are analyzed with a regression analysis using either SAS™ or Statgraphics™ software with the intercept forced through zero. The correlation factor between XRF and AA/ICP data should be 0.7 or greater.

### 10.2 Recording Results

Record all results and monitoring activities in a laboratory or field notebook. Alternatively, record results electronically on a hard drive or floppy disk.

### 10.3 Downloading Stored Results and Spectra

Results (analytical reports) and spectra which have been stored in the Spectrace 9000 internal memory should be downloaded and captured in disk files on a PC (see Section 5). Spectrace Instruments provides software for this purpose. Additionally, they provide software to prepare results or spectra for importing into a spreadsheet. Refer to the instructions provided

## 12.0 REFERENCES

1. Spectrace 9000 Portable XRF Analyzer Operating Instructions, Revision 0.3, January, 1992.
2. Bernik, Mark, P. Berry, G. Voots, G. Prince, et. al., "A High Resolution Portable XRF HgI<sub>2</sub> Spectrometer for Field Screening of Hazardous Metal Wastes," Pacific-International Congress on X-ray Analytical Methods, August, 1991.
3. Bernik, Mark, "Thin Film Standard Evaluation of the OEI X-MET 880 HEPS Probe and the Spectrace 9000 Field Portable X-ray Fluorescence Analyzers," USEPA Contract No. 68-03-3482, March, 1992.
4. "X-ray Fluorescence Spectrometry: Uses and Applications at Hazardous Waste Sites," HMCRI Research and Development Conference, San Francisco, California, February, 1992.
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7. Dzubay, T. Ed, "X-ray Fluorescence Analysis of Environmental Samples," Ann Arbor Science, 1977, p. 310.
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  12. J. Rhodes, J. Stout, J. Schlinder, S. Piorek, "Portable X-ray Survey Meters for In Situ Trace Element Monitoring of Air Particles," American Society for Testing and Materials, Special Technical Publication 786, 1982, pp. 70 - 82.
  13. S. Piorek, J. Rhodes, "In Situ Analysis of Waste Water Using Portable Pre-concentration Techniques and a Portable XRF Analyzer," Presented at the Electron Microscopy and X-ray Applications to Environmental and Occupational Health Analysis Symposium, Penn. State Univ., Oct. 14 - 17, 1980.
  14. S. Piorek, J. Rhodes, "Hazardous Waste Screening Using a Portable X-ray Analyzer," Presented at the Symposium on Waste Minimization and Environmental Programs within D.O.D., American Defense Preparedness Assoc., Long Beach, CA., April 1987.
  15. "Field-Portable X-Ray Fluorescence," US EPA/ERT Quality Assurance Technical Information Bulletin, Vol. 1, No. 4, May 1991.



## **APPENDIX E**

### **XRF DATA**



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 08:27:26

ID: &lt;ECAL&gt;

( ) ( )

	Value	Std. dev.	
K	980.000	297.000	ppm
Ca	13950.0	381.000	ppm
CrLO	180.000	151.000	ppm
Fe	370.000	304.000	ppm
Zn	305.000	82.9000	ppm
Sr	86.0000	51.2000	ppm
Mo	172.000	30.2000	ppm
Pb	171100	1710.00	ppm
Rb	261.000	59.0000	ppm
Cd	554.000	95.4000	ppm
Sn	219.000	61.3000	ppm
Sb	140.000	42.0000	ppm
Ba	117.000	17.8000	ppm
Th	338.000	60.5000	ppm

Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 08:38:13

ID: &lt;RESCHK&gt;

( ) ( )

	Value	Std. dev.	
CrHI	231.000	84.8000	ppm
K	210.000	147.000	ppm
Ca	73.0000	71.6000	ppm
Mn	1600.00	1530.00	ppm
Fe	1.59200e+06	10600.0	ppm
Zn	940.000	180.000	ppm
Mo	41.0000	19.7000	ppm
Pb	460.000	147.000	ppm
Cd	1260.00	336.000	ppm
Sb	190.000	124.000	ppm
U	7.30000	4.54000	ppm

Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 08:50:04

ID: &lt;ZERO&gt;

( ) ( )

	Value	Std. dev.	
K	340.000	150.000	ppm
Ca	242.000	74.6000	ppm
CrLO	111.000	87.1000	ppm
Cu	94.0000	53.1000	ppm
Sr	10.9000	5.23000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994  
 Meas Time: 6-DEC-1994 09:13:08  
 ID: <NIST-2709>  
 ( ) ( )

	Value	Std. dev.
CrHI	74.0000	58.1000 ppm
K	22100.0	1300.00 ppm
Ca	22180.0	915.000 ppm
Ti	3110.00	394.000 ppm
CrLO	260.000	248.000 ppm
Mn	622.000	71.4000 ppm
Fe	31360.0	246.000 ppm
Cu	45.0000	10.7000 ppm
Zn	164.000	10.4000 ppm
As	31.7000	6.66000 ppm
Sr	270.700	4.13000 ppm
Zr	156.400	2.17000 ppm
Mo	3.40000	1.02000 ppm
Pb	30.0000	3.99000 ppm
Rb	113.500	3.81000 ppm
Sb	67.0000	44.3000 ppm
Ba	680.000	45.4000 ppm
U	3.90000	2.43000 ppm
Th	4.90000	1.57000 ppm

Application:SOILS with U,Th,Ag Q044 05-27-1994  
 Meas Time: 6-DEC-1994 09:37:37  
 ID: <NIST2709>  
 ( ) ( )

	Value	Std. dev.
CrHI	187.000	60.9000 ppm
K	23000.0	1330.00 ppm
Ca	23230.0	937.000 ppm
Ti	3060.00	398.000 ppm
Mn	627.000	71.8000 ppm
Fe	31470.0	249.000 ppm
Co	147.000	66.9000 ppm
Cu	38.0000	10.6000 ppm
Zn	151.000	10.2000 ppm
As	17.6000	6.73000 ppm
Sr	272.400	4.16000 ppm
Zr	161.100	2.21000 ppm
Mo	3.80000	1.04000 ppm
Pb	41.3000	4.19000 ppm
Rb	111.000	3.80000 ppm
Ba	599.000	43.1000 ppm
U	5.90000	2.45000 ppm
Th	2.10000	1.55000 ppm



## Pyridium Site 1 - XRF Data - 12/6/94

ID	TIME	Hg
G170-4	10.80	67 B
G170-6.5	11.38	U
E210-1.5	11.78	U
E90-7	12.19	U
D130-7	12.54	U
D190-2	13.49	U
B70-3	14.34	U
B130-1	14.74	U
BB-2	15.52	U
B160-1	15.86	U
UNKNOWN	16.51	U
G70-0.5	16.94	U
G70-1.5	17.28	168
DD-5.5	17.63	U

NIST2709	9.22	0
NIST2709	9.63	0
NIST2709	10.44	0
NIST2709	13.87	-17.1
NIST2709	15.10	-26.7
NIST2709	17.96	-21.1



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 10:26:32

ID: &lt;&gt;

( ) ( )

	Value	Std. dev.
CrHI	205.000	61.4000 ppm
K	24600.0	1370.00 ppm
Ca	22790.0	934.000 ppm
Ti	3050.00	421.000 ppm
Mn	715.000	73.6000 ppm
Fe	31570.0	251.000 ppm
Cu	30.0000	10.5000 ppm
Zn	150.000	10.2000 ppm
As	32.9000	6.69000 ppm
Sr	272.500	4.17000 ppm
Zr	160.400	2.21000 ppm
Mo	3.70000	1.04000 ppm
Pb	28.3000	3.99000 ppm
Rb	113.400	3.85000 ppm
Ba	510.000	40.2000 ppm
U	5.50000	2.45000 ppm
Th	4.50000	1.57000 ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 10:48:09

ID: &lt;G170-4&gt;

( ) ( )

	Value	Std. dev.	
K	18100.0	1220.00	ppm
Ca	59600.0	1430.00	ppm
Ti	3250.00	413.000	ppm
Mn	441.000	69.4000	ppm
Fe	20090.0	190.000	ppm
Cu	29.0000	10.5000	ppm
Zn	116.000	9.89000	ppm
As	8.40000	6.46000	ppm
Sr	90.7000	2.51000	ppm
Zr	358.200	3.23000	ppm
Mo	4.30000	1.18000	ppm
Hg	67.0000	9.23000	ppm
Pb	30.4000	4.04000	ppm
Rb	94.4000	3.65000	ppm
Ba	271.000	31.6000	ppm
U	6.60000	2.39000	ppm
Th	2.70000	1.59000	ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 11:22:30

ID: &lt;G170-6.5&gt;

( ) ( )

	Value	Std. dev.
CrHI	131.000	65.0000 ppm
K	28100.0	1460.00 ppm
Ca	42500.0	1250.00 ppm
Ti	3380.00	417.000 ppm
Mn	1747.00	95.5000 ppm
Fe	30840.0	257.000 ppm
Cu	52.0000	11.5000 ppm
Zn	131.000	10.4000 ppm
As	7.50000	6.71000 ppm
Sr	73.8000	2.38000 ppm
Zr	249.300	2.70000 ppm
Mo	5.20000	1.17000 ppm
Pb	29.6000	4.25000 ppm
Rb	114.100	4.00000 ppm
Ba	311.000	34.8000 ppm
U	7.30000	2.43000 ppm
Th	5.60000	1.56000 ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 11:46:52

ID: &lt;E210-1.5&gt;

( ) ( )

	Value	Std. dev.
CrHI	245.000	61.5000 ppm
K	19000.0	1210.00 ppm
Ca	9260.00	622.000 ppm
Ti	4190.00	402.000 ppm
Mn	1521.00	86.3000 ppm
Fe	27540.0	219.000 ppm
Cu	14.2000	9.68000 ppm
Zn	102.100	9.15000 ppm
As	21.3000	6.45000 ppm
Sr	63.9000	2.11000 ppm
Zr	393.200	3.20000 ppm
Mo	7.80000	1.19000 ppm
Pb	36.6000	3.96000 ppm
Rb	64.2000	3.16000 ppm
Sb	61.0000	47.8000 ppm
Ba	173.000	26.2000 ppm
Ag	144.000	82.7000 ppm
U	11.5000	2.32000 ppm
Th	2.10000	1.59000 ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 12:11:23

ID: &lt;&gt;

( ) ( )

	Value	Std. dev.
CrHI	92.0000	55.5000 ppm
K	3590.00	746.000 ppm
Ca	62400.0	1410.00 ppm
Ti	1310.00	255.000 ppm
CrLO	450.000	229.000 ppm
Mn	658.000	61.6000 ppm
Fe	7330.00	104.000 ppm
Cu	103.000	12.1000 ppm
Zn	130.000	11.0000 ppm
As	32.8000	7.17000 ppm
Sr	90.8000	2.38000 ppm
Zr	89.5000	1.55000 ppm
Mo	6.40000	1.08000 ppm
Pb	39.9000	4.18000 ppm
Rb	14.0000	3.08000 ppm
Ba	14.0000	12.9000 ppm
U	80.6000	2.92000 ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 12:32:05

ID: &lt;D130-7&gt;

( ) ( )

	Value	Std. dev.
CrHI	175.000	57.6000 ppm
K	12600.0	1030.00 ppm
Ca	22650.0	897.000 ppm
Ti	2810.00	365.000 ppm
CrLO	530.000	253.000 ppm
Mn	587.000	63.0000 ppm
Fe	13120.0	139.000 ppm
Cu	48.0000	11.1000 ppm
Zn	142.000	11.1000 ppm
As	12.2000	6.94000 ppm
Sr	73.9000	2.16000 ppm
Zr	194.200	2.13000 ppm
Pb	38.9000	4.25000 ppm
Rb	66.7000	3.20000 ppm
Ba	80.0000	18.7000 ppm
Ag	119.000	67.8000 ppm
U	18.2000	2.57000 ppm
Th	10.6000	1.76000 ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 13:29:29

ID: &lt;D190-2&gt;

( ) ( )

	Value	Std. dev.	
CrHI	257.000	62.8000	ppm
K	30000.0	1490.00	ppm
Ca	4570.00	519.000	ppm
Ti	4180.00	406.000	ppm
CrLO	110.000	220.000	ppm
Mn	1771.00	92.7000	ppm
Fe	34850.0	270.000	ppm
Co	40.0000	69.1000	ppm
Ni	-69.0000	18.5000	ppm
Cu	33.0000	10.6000	ppm
Zn	163.000	10.5000	ppm
As	8.20000	6.81000	ppm
Se	-16.1000	3.86000	ppm
Sr	72.6000	2.29000	ppm
Zr	314.000	2.96000	ppm
Mo	2.50000	1.14000	ppm
Hg	-38.0000	7.26000	ppm
Pb	48.4000	4.36000	ppm
Rb	111.200	3.86000	ppm
Cd	53.0000	131.600	ppm
Sn	130.000	81.6000	ppm
Sb	-27.0000	46.2000	ppm
Ba	297.000	33.0000	ppm
Ag	-7.60000	79.8900	ppm
U	7.70000	2.44000	ppm
Th	3.80000	1.59000	ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 13:52:06

ID: &lt;NIST2709&gt;

( ) ( )

	Value	Std. dev.
CrHI	173.000	58.6000 ppm
K	22500.0	1320.00 ppm
Ca	23440.0	939.000 ppm
Ti	3500.00	413.000 ppm
CrLO	110.000	238.000 ppm
Mn	632.000	70.5000 ppm
Fe	31690.0	249.000 ppm
Co	-83.0000	65.3000 ppm
Ni	28.0000	20.0000 ppm
Cu	29.0000	10.5000 ppm
Zn	167.000	10.5000 ppm
As	23.5000	6.76000 ppm
Se	-15.3000	3.85000 ppm
Sr	271.700	4.15000 ppm
Zr	156.300	2.18000 ppm
Mo	3.30000	1.03000 ppm
Hg	-17.1000	7.65000 ppm
Pb	37.8000	4.19000 ppm
Rb	114.900	3.87000 ppm
Cd	-160.000	110.000 ppm
Sn	16.0000	70.4000 ppm
Sb	36.0000	42.3000 ppm
Ba	647.000	44.6000 ppm
Ag	66.0000	74.0000 ppm
U	6.70000	2.47000 ppm
Th	6.40000	1.59000 ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 14:20:25

ID: &lt;B70-3&gt;

( ) ( )

	Value	Std. dev.
CrHI	163.000	56.8000 ppm
K	16800.0	1140.00 ppm
Ca	3540.00	429.000 ppm
Ti	4130.00	386.000 ppm
CrLO	520.000	229.000 ppm
Mn	1110.00	76.3000 ppm
Fe	21210.0	182.000 ppm
Co	21.0000	53.4000 ppm
Ni	-62.0000	16.1000 ppm
Cu	2.00000	8.94000 ppm
Zn	128.600	9.25000 ppm
As	11.6000	5.82000 ppm
Se	-11.3000	3.53000 ppm
Sr	63.7000	2.02000 ppm
Zr	376.700	3.02000 ppm
Mo	5.60000	1.11000 ppm
Hg	-22.2000	6.73000 ppm
Pb	25.0000	3.60000 ppm
Rb	78.2000	3.18000 ppm
Cd	-92.0000	113.300 ppm
Sn	-15.0000	68.9000 ppm
Sb	42.0000	43.4000 ppm
Ba	202.000	26.7000 ppm
Ag	63.0000	74.3000 ppm
U	8.00000	2.40000 ppm
Th	5.50000	1.65000 ppm



Application: SOILS with U, Th, Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 14:44:13

ID: &lt;B130-1&gt;

( ) ( )

	Value	Std. dev.
CrHI	192.000	60.1000 ppm
K	18700.0	1210.00 ppm
Ca	21050.0	885.000 ppm
Ti	4120.00	412.000 ppm
CrLO	250.000	237.000 ppm
Mn	1124.00	79.6000 ppm
Fe	25920.0	214.000 ppm
Co	-103.000	58.9000 ppm
Ni	-45.0000	17.7000 ppm
Cu	75.0000	11.2000 ppm
Zn	97.7000	9.32000 ppm
As	2.70000	8.52000 ppm
Se	-12.1000	3.84000 ppm
Sr	82.2000	2.35000 ppm
Zr	329.500	2.96000 ppm
Mo	5.00000	1.14000 ppm
Hg	-5.40000	7.67000 ppm
Pb	150.100	5.95000 ppm
Rb	79.3000	3.37000 ppm
Cd	22.0000	124.700 ppm
Sn	238.000	82.4000 ppm
Sb	9.80000	45.7900 ppm
Ba	276.000	31.3000 ppm
Ag	64.0000	79.4000 ppm
U	8.20000	2.36000 ppm
Th	5.20000	1.70000 ppm



Application: SOILS with U, Th, Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 15:06:15

ID: &lt;NIST-2709&gt;

( ) ( )

	Value	Std. dev.	
CrHI	187.000	58.4000	ppm
K	22900.0	1330.00	ppm
Ca	23220.0	937.000	ppm
Ti	2690.00	413.000	ppm
CrLO	-170.000	242.000	ppm
Mn	775.000	72.9000	ppm
Fe	31640.0	250.000	ppm
Co	15.0000	66.0000	ppm
Ni	-17.0000	19.2000	ppm
Cu	50.0000	10.9000	ppm
Zn	144.000	10.1000	ppm
As	20.7000	6.63000	ppm
Se	-17.8000	3.80000	ppm
Sr	286.000	4.26000	ppm
Zr	160.500	2.21000	ppm
Mo	6.00000	1.05000	ppm
Hg	-26.7000	7.44000	ppm
Pb	34.2000	4.10000	ppm
Rb	117.000	3.86000	ppm
Cd	79.0000	117.600	ppm
Sn	7.60000	70.1100	ppm
Sb	12.0000	43.4000	ppm
Ba	585.000	42.7000	ppm
Ag	112.000	76.1000	ppm
U	1.90000	2.44000	ppm
Th	6.00000	1.58000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 15:31:18

ID: &lt;BB-2&gt;

( ) ( )

	Value	Std. dev.
CrHI	122.000	58.7000 ppm
K	30200.0	1500.00 ppm
Ca	5840.00	561.000 ppm
Ti	4820.00	432.000 ppm
CrLO	-25.0000	216.000 ppm
Mn	1236.00	83.4000 ppm
Fe	30920.0	250.000 ppm
Co	9.30000	65.0400 ppm
Ni	-31.0000	18.8000 ppm
Cu	77.0000	11.5000 ppm
Zn	223.000	11.3000 ppm
As	-5.40000	7.39000 ppm
Se	-17.0000	3.80000 ppm
Sr	75.5000	2.31000 ppm
Zr	355.700	3.16000 ppm
Mo	5.30000	1.18000 ppm
Hg	-28.5000	7.34000 ppm
Pb	88.8000	5.02000 ppm
Rb	94.8000	3.63000 ppm
Cd	-170.000	124.000 ppm
Sn	-80.0000	74.5000 ppm
Sb	103.000	50.2000 ppm
Ba	315.000	33.3000 ppm
Ag	135.000	85.1000 ppm
U	8.70000	2.42000 ppm
Th	2.70000	1.62000 ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 15:51:23

ID: &lt;B160-1&gt;

( ) ( )

	Value	Std. dev.
CrHI	96.0000	53.4000 ppm
K	14800.0	1080.00 ppm
Ca	8160.00	576.000 ppm
Ti	3450.00	347.000 ppm
CrLO	-93.0000	167.800 ppm
Mn	942.000	71.8000 ppm
Fe	20500.0	177.000 ppm
Co	-12.0000	52.3000 ppm
Ni	-88.0000	15.4000 ppm
Cu	25.0000	9.48000 ppm
Zn	162.500	9.83000 ppm
As	13.3000	7.12000 ppm
Se	-17.6000	3.45000 ppm
Sr	64.7000	2.04000 ppm
Zr	326.800	2.77000 ppm
Mo	3.80000	1.05000 ppm
Hg	-21.1000	6.80000 ppm
Pb	88.7000	4.70000 ppm
Rb	69.6000	3.04000 ppm
Cd	-19.0000	110.500 ppm
Sn	-53.0000	64.9000 ppm
Sb	-9.70000	39.5800 ppm
Ba	198.000	26.1000 ppm
Ag	112.000	73.6000 ppm
U	6.30000	2.32000 ppm
Th	3.70000	1.64000 ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 16:30:34

ID: &lt;DD-5.5&gt;

( ) ( )

	Value	Std. dev.
CrHI	112.000	57.6000 ppm
K	17600.0	1180.00 ppm
Ca	20460.0	869.000 ppm
Ti	3960.00	385.000 ppm
CrLO	500.000	236.000 ppm
Mn	1407.00	83.4000 ppm
Fe	25750.0	212.000 ppm
Co	-75.0000	58.9000 ppm
Ni	-55.0000	17.4000 ppm
Cu	35.0000	10.3000 ppm
Zn	200.000	10.9000 ppm
As	-1.00000	8.48000 ppm
Se	-16.6000	3.76000 ppm
Sr	75.6000	2.27000 ppm
Zr	304.700	2.81000 ppm
Mo	0.900000	1.08000 ppm
Hg	5.80000	7.89000 ppm
Pb	152.000	5.92000 ppm
Rb	82.1000	3.39000 ppm
Cd	19.0000	129.000 ppm
Sn	-56.0000	74.6000 ppm
Sb	65.0000	49.9000 ppm
Ba	274.000	31.3000 ppm
Ag	65.0000	82.2000 ppm
U	8.80000	2.37000 ppm
Th	4.70000	1.69000 ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 16:56:11

ID: &lt;G70-0.5&gt;

( ) ( )

	Value	Std. dev.
CrHI	81.0000	55.4000 ppm
K	18700.0	1210.00 ppm
Ca	17500.0	814.000 ppm
Ti	3700.00	371.000 ppm
CrLO	190.000	212.000 ppm
Mn	1016.00	75.9000 ppm
Fe	26160.0	214.000 ppm
Co	-77.0000	59.0000 ppm
Ni	-41.0000	17.6000 ppm
Cu	23.7000	9.98000 ppm
Zn	224.000	11.1000 ppm
As	-2.80000	8.23000 ppm
Se	-18.7000	3.66000 ppm
Sr	70.6000	2.20000 ppm
Zr	275.500	2.65000 ppm
Mo	3.20000	1.07000 ppm
Hg	10.5000	7.88000 ppm
Pb	142.600	5.73000 ppm
Rb	81.5000	3.36000 ppm
Cd	-120.000	122.000 ppm
Sn	66.0000	77.1000 ppm
Sb	-4.70000	44.1000 ppm
Ba	312.000	32.6000 ppm
Ag	36.0000	79.1000 ppm
U	8.10000	2.34000 ppm
Th	2.10000	1.63000 ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 17:16:58

ID: &lt;G70-1.5&gt;

( ) ( )

	Value	Std. dev.	
CrHI	200.000	62.5000	ppm
K	18800.0	1230.00	ppm
Ca	46700.0	1280.00	ppm
Ti	4560.00	397.000	ppm
CrLO	-95.0000	185.300	ppm
Mn	734.000	73.9000	ppm
Fe	24470.0	213.000	ppm
Co	27.0000	60.1000	ppm
Ni	-59.0000	18.1000	ppm
Cu	26.0000	10.5000	ppm
Zn	324.000	12.9000	ppm
As	4.10000	7.34000	ppm
Se	-14.3000	3.97000	ppm
Sr	89.5000	2.53000	ppm
Zr	225.300	2.49000	ppm
Mo	4.30000	1.09000	ppm
Hg	168.000	10.9000	ppm
Pb	73.9000	4.85000	ppm
Rb	97.2000	3.67000	ppm
Cd	120.000	144.000	ppm
Sn	-8.40000	83.0500	ppm
Sb	-47.0000	49.7000	ppm
Ba	327.000	34.7000	ppm
Ag	25.0000	88.2000	ppm
U	7.50000	2.40000	ppm
Th	3.80000	1.58000	ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 17:37:48

ID: &lt;DD-5.5&gt;

( ) ( )

	Value	Std. dev.
CrHI	147.000	57.3000 ppm
K	9740.00	960.000 ppm
Ca	46800.0	1250.00 ppm
Ti	2310.00	316.000 ppm
CrLO	270.000	230.000 ppm
Mn	393.000	58.1000 ppm
Fe	12880.0	140.000 ppm
Co	86.0000	47.3000 ppm
Ni	-71.0000	17.5000 ppm
Cu	59.0000	11.7000 ppm
Zn	136.000	11.4000 ppm
As	31.1000	7.38000 ppm
Se	-9.90000	4.19000 ppm
Sr	73.0000	2.21000 ppm
Zr	132.500	1.83000 ppm
Mo	5.50000	1.09000 ppm
Hg	-18.6000	7.99000 ppm
Pb	37.6000	4.37000 ppm
Rb	39.4000	3.27000 ppm
Cd	25.0000	99.4000 ppm
Sn	-66.0000	56.6000 ppm
Sb	-36.0000	33.7000 ppm
Ba	44.0000	16.1000 ppm
Ag	83.0000	65.0000 ppm
U	53.0000	2.77000 ppm
Th	3.10000	1.68000 ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 6-DEC-1994 17:57:30

ID: &lt;NIST2709&gt;

( ) ( )

	Value	Std. dev.	
CrHI	91.0000	55.3000	ppm
K	23700.0	1350.00	ppm
Ca	21390.0	905.000	ppm
Ti	3010.00	410.000	ppm
CrLO	120.000	249.000	ppm
Mn	676.000	70.5000	ppm
Fe	31650.0	250.000	ppm
Co	102.000	66.6000	ppm
Ni	-35.0000	18.9000	ppm
Cu	18.0000	10.2000	ppm
Zn	164.000	10.4000	ppm
As	23.0000	6.52000	ppm
Se	-27.6000	3.61000	ppm
Sr	268.200	4.12000	ppm
Zr	159.700	2.19000	ppm
Mo	2.80000	1.01000	ppm
Hg	-21.1000	7.57000	ppm
Pb	29.0000	3.92000	ppm
Rb	113.600	3.83000	ppm
Cd	22.0000	116.700	ppm
Sn	186.000	77.5000	ppm
Sb	35.0000	44.4000	ppm
Ba	573.000	42.4000	ppm
Ag	118.000	76.8000	ppm
U	3.30000	2.42000	ppm
Th	4.00000	1.55000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 08:32:02

ID: &lt;ECAL&gt;

( ) ( )

	Value	Std. dev.	
CrHI	22.0000	685.600	ppm
K	1370.00	310.000	ppm
Ca	14240.0	386.000	ppm
Ti	61.0000	87.6000	ppm
CrLO	460.000	158.000	ppm
Mn	420.000	586.000	ppm
Fe	980.000	334.000	ppm
Co	110.000	231.000	ppm
Ni	110.000	167.000	ppm
Cu	200.000	106.000	ppm
Zn	153.000	77.1000	ppm
As	-6220.00	982.000	ppm
Se	-290.000	100.000	ppm
Sr	68.0000	50.5000	ppm
Zr	-204.000	56.0000	ppm
Mo	120.000	30.1000	ppm
Hg	-67.0000	129.500	ppm
Pb	170900	1710.00	ppm
Rb	264.000	60.0000	ppm
Cd	587.000	95.8000	ppm
Sn	317.000	65.0000	ppm
Sb	170.000	43.5000	ppm
Ba	92.0000	16.3000	ppm
Ag	87.0000	48.8000	ppm
U	-79.0000	24.4000	ppm
Th	275.000	60.0000	ppm

Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 08:41:15

ID: &lt;RESCHK&gt;

( ) ( )

	Value	Std. dev.	
CrHI	117.000	81.2000	ppm
K	190.000	142.000	ppm
Ca	138.000	70.4000	ppm
Ti	-116.000	58.0000	ppm
CrLO	-46.0000	85.7000	ppm
Mn	2000.00	1530.00	ppm
Fe	1.58900e+06	10600.0	ppm
Co	-5300.00	2880.00	ppm
Ni	740.000	1341.00	ppm
Cu	180.000	320.000	ppm
Zn	990.000	186.000	ppm
As	-31.0000	206.400	ppm
Se	-6.50000	76.3700	ppm
Sr	-13.0000	31.8000	ppm
Zr	45.0000	21.8000	ppm
Mo	8.10000	20.6500	ppm
Hg	-410.000	221.000	ppm
Pb	500.000	152.000	ppm
Rb	31.0000	71.5000	ppm
Cd	1030.00	333.000	ppm
Sn	550.000	198.000	ppm
Sb	320.000	127.000	ppm
Ba	47.0000	36.2000	ppm
Ag	-430.000	177.000	ppm
U	16.3000	5.40000	ppm
Th	-11.8000	4.36000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 08:47:59

ID: &lt;ZERO&gt;

( ) ( )

	Value	Std. dev.	
CrHI	-220.000	251.000	ppm
K	44.0000	136.700	ppm
Ca	2.50000	63.9900	ppm
Ti	-63.0000	52.3000	ppm
CrLO	211.000	89.4000	ppm
Mn	540.000	247.000	ppm
Fe	-78.0000	127.300	ppm
Co	-47.0000	115.200	ppm
Ni	35.0000	76.5000	ppm
Cu	-52.0000	44.5000	ppm
Zn	-47.0000	46.8000	ppm
As	9.40000	30.1000	ppm
Se	3.10000	18.6000	ppm
Sr	3.60000	4.84000	ppm
Zr	7.00000	3.21000	ppm
Mo	-0.300000	3.59000	ppm
Hg	53.0000	37.6000	ppm
Pb	7.10000	16.8200	ppm
Rb	-0.200000	9.25000	ppm
Cd	118.000	53.1000	ppm
Sn	-31.0000	30.3000	ppm
Sb	-22.0000	19.0000	ppm
Ba	9.20000	6.94000	ppm
Ag	-25.0000	32.1000	ppm
U	11.0000	10.7000	ppm
Th	-2.80000	7.86000	ppm

Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 09:10:58

ID: &lt;NIST2709&gt;

( ) ( )

	Value	Std. dev.	
CrHI	255.000	62.6000	ppm
K	25300.0	1390.00	ppm
Ca	21870.0	918.000	ppm
Ti	2710.00	402.000	ppm
CrLO	-200.000	227.000	ppm
Mn	629.000	72.2000	ppm
Fe	31410.0	251.000	ppm
Co	186.000	67.2000	ppm
Ni	-49.0000	18.8000	ppm
Cu	29.0000	10.4000	ppm
Zn	152.000	10.2000	ppm
As	17.8000	6.46000	ppm
Se	-22.2000	3.71000	ppm
Sr	270.600	4.15000	ppm
Zr	163.200	2.22000	ppm
Mo	1.10000	1.01000	ppm
Hg	-11.5000	7.73000	ppm
Pb	31.7000	3.92000	ppm
Rb	113.800	3.84000	ppm
Cd	-160.000	107.000	ppm
Sn	-139.000	60.8000	ppm
Sb	32.0000	40.8000	ppm
Ba	630.000	43.8000	ppm
Ag	-26.0000	67.1000	ppm
U	6.00000	2.45000	ppm
Th	3.30000	1.56000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 09:30:40

ID: &lt;NIST2709&gt;

( ) ( )

	Value	Std. dev.	
CrHI	249.000	62.3000	ppm
K	21600.0	1290.00	ppm
Ca	22050.0	912.000	ppm
Ti	3690.00	419.000	ppm
CrLO	100.000	241.000	ppm
Mn	730.000	73.6000	ppm
Fe	31430.0	247.000	ppm
Co	143.000	66.7000	ppm
Ni	-28.0000	19.1000	ppm
Cu	22.0000	10.2000	ppm
Zn	149.000	10.1000	ppm
As	16.3000	6.51000	ppm
Se	-21.5000	3.70000	ppm
Sr	274.100	4.16000	ppm
Zr	155.000	2.17000	ppm
Mo	4.50000	1.02000	ppm
Hg	-18.3000	7.57000	ppm
Pb	34.0000	4.03000	ppm
Rb	113.500	3.82000	ppm
Cd	-48.0000	109.700	ppm
Sn	129.000	71.8000	ppm
Sb	-11.0000	39.3000	ppm
Ba	512.000	40.0000	ppm
Ag	-0.200000	68.1100	ppm
U	3.90000	2.43000	ppm
Th	4.40000	1.57000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 09:51:49

ID: &lt;A1\_1.5-2.0&gt;

( ) ( )

	Value	Std. dev.	
CrHI	83.0000	61.1000	ppm
K	22500.0	1310.00	ppm
Ca	9080.00	627.000	ppm
Ti	3500.00	387.000	ppm
CrLO	380.000	236.000	ppm
Mn	1536.00	88.3000	ppm
Fe	31440.0	243.000	ppm
Co	110.000	65.8000	ppm
Ni	-16.0000	19.1000	ppm
Cu	51.0000	10.9000	ppm
Zn	312.000	12.5000	ppm
As	-7.80000	9.90000	ppm
Se	-15.1000	3.85000	ppm
Sr	69.2000	2.22000	ppm
Zr	259.400	2.61000	ppm
Mo	4.90000	1.09000	ppm
Hg	-1.70000	7.88000	ppm
Pb	239.000	7.17000	ppm
Rb	94.1000	3.58000	ppm
Cd	-190.000	127.000	ppm
Sn	33.0000	79.3000	ppm
Sb	79.0000	50.1000	ppm
Ba	322.000	33.7000	ppm
Ag	-21.0000	80.5000	ppm
U	5.60000	2.37000	ppm
Th	7.80000	1.76000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 10:16:27

ID: &lt;A2\_0-1.5&gt;

( ) ( )

	Value	Std. dev.	
CrHI	167.000	59.7000	ppm
K	22800.0	1310.00	ppm
Ca	12050.0	703.000	ppm
Ti	3800.00	369.000	ppm
CrLO	550.000	227.000	ppm
Mn	1244.00	82.1000	ppm
Fe	28520.0	229.000	ppm
Co	123.000	63.0000	ppm
Ni	-110.000	16.5000	ppm
Cu	53.0000	10.5000	ppm
Zn	253.000	11.3000	ppm
As	-8.50000	9.28000	ppm
Se	-20.3000	3.60000	ppm
Sr	63.4000	2.13000	ppm
Zr	302.800	2.82000	ppm
Mo	4.10000	1.08000	ppm
Hg	7.20000	7.79000	ppm
Pb	213.700	6.68000	ppm
Rb	78.4000	3.33000	ppm
Cd	-140.000	116.000	ppm
Sn	45.0000	73.2000	ppm
Sb	39.0000	44.4000	ppm
Ba	210.000	28.0000	ppm
Ag	-4.80000	73.9700	ppm
U	7.30000	2.28000	ppm
Th	-0.500000	1.64000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 10:37:20

ID: &lt;B\_1.5-3.0&gt;

( ) ( )

	Value	Std. dev.	
CrHI	50.0000	57.6000	ppm
K	18700.0	1200.00	ppm
Ca	8000.00	583.000	ppm
Ti	2950.00	347.000	ppm
CrLO	450.000	221.000	ppm
Mn	2530.00	101.000	ppm
Fe	33020.0	244.000	ppm
Co	32.0000	66.4000	ppm
Ni	-55.0000	18.0000	ppm
Cu	45.0000	10.5000	ppm
Zn	229.000	11.1000	ppm
As	-16.4000	8.68000	ppm
Se	-15.9000	3.74000	ppm
Sr	51.9000	1.99000	ppm
Zr	249.700	2.52000	ppm
Mo	5.00000	1.07000	ppm
Hg	-13.7000	7.47000	ppm
Pb	175.700	6.23000	ppm
Rb	101.200	3.59000	ppm
Cd	-110.000	124.000	ppm
Sn	-34.0000	74.3000	ppm
Sb	-28.0000	43.3000	ppm
Ba	323.000	33.3000	ppm
Ag	43.0000	80.2000	ppm
U	2.70000	2.35000	ppm
Th	1.10000	1.62000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 10:37:20

ID: &lt;B\_1.5-3.0&gt;

( ) ( )

	Value	Std. dev.	
CrHI	50.0000	57.6000	ppm
K	18700.0	1200.00	ppm
Ca	8000.00	583.000	ppm
Ti	2950.00	347.000	ppm
CrLO	450.000	221.000	ppm
Mn	2530.00	101.000	ppm
Fe	33020.0	244.000	ppm
Co	32.0000	66.4000	ppm
Ni	-55.0000	18.0000	ppm
Cu	45.0000	10.5000	ppm
Zn	229.000	11.1000	ppm
As	-16.4000	8.68000	ppm
Se	-15.9000	3.74000	ppm
Sr	51.9000	1.99000	ppm
Zr	249.700	2.52000	ppm
Mo	5.00000	1.07000	ppm
Hg	-13.7000	7.47000	ppm
Pb	175.700	6.23000	ppm
Rb	101.200	3.59000	ppm
Cd	-110.000	124.000	ppm
Sn	-34.0000	74.3000	ppm
Sb	-28.0000	43.3000	ppm
Ba	323.000	33.3000	ppm
Ag	43.0000	80.2000	ppm
U	2.70000	2.35000	ppm
Th	1.10000	1.62000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 10:58:27

ID: &lt;C1\_3.0-5.0&gt;

( ) ( )

	Value	Std. dev.
CrHI	46.0000	57.4000 ppm
K	23200.0	1320.00 ppm
Ca	1870.00	390.000 ppm
Ti	5540.00	454.000 ppm
CrLO	78.0000	224.700 ppm
Mn	1011.00	79.1000 ppm
Fe	28390.0	227.000 ppm
Co	141.000	62.7000 ppm
Ni	-55.0000	17.9000 ppm
Cu	14.2000	9.80000 ppm
Zn	152.000	10.1000 ppm
As	23.0000	6.35000 ppm
Se	-24.3000	3.53000 ppm
Sr	72.4000	2.22000 ppm
Zr	422.900	3.38000 ppm
Mo	2.80000	1.18000 ppm
Hg	-15.6000	7.36000 ppm
Pb	26.9000	3.87000 ppm
Rb	83.2000	3.44000 ppm
Cd	-37.0000	122.100 ppm
Sn	19.0000	74.1000 ppm
Sb	82.0000	48.5000 ppm
Ba	351.000	34.1000 ppm
Ag	17.0000	76.7000 ppm
U	11.3000	2.42000 ppm
Th	7.50000	1.67000 ppm



Application: SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 11:20:31

ID: &lt;82-1-5-2&gt;

( ) ( )

	Value	Std. dev.
CrHI	166.000	61.9000 ppm
K	20200.0	1260.00 ppm
Ca	25880.0	976.000 ppm
Ti	5100.00	461.000 ppm
CrLO	250.000	246.000 ppm
Mn	1511.00	88.6000 ppm
Fe	33200.0	257.000 ppm
Co	198.000	69.4000 ppm
Ni	-42.0000	19.5000 ppm
Cu	196.000	14.0000 ppm
Zn	755.000	17.7000 ppm
As	-61.0000	13.8000 ppm
Se	-21.8000	3.95000 ppm
Sr	90.8000	2.57000 ppm
Zr	270.000	2.76000 ppm
Mo	5.80000	1.16000 ppm
Hg	-12.1000	8.10000 ppm
Pb	555.000	10.6000 ppm
Rb	89.2000	3.69000 ppm
Cd	-150.000	122.000 ppm
Sn	81.0000	78.3000 ppm
Sb	13.0000	44.9000 ppm
Ba	380.000	36.3000 ppm
Ag	20.0000	78.6000 ppm
U	7.60000	2.34000 ppm
Th	4.60000	1.88000 ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 11:41:30

ID: &lt;NIST2709&gt;

( ) ( )

	Value	Std. dev.	
CrHI	189.000	59.4000	ppm
K	22200.0	1310.00	ppm
Ca	23260.0	935.000	ppm
Ti	3520.00	420.000	ppm
CrLO	140.000	246.000	ppm
Mn	791.000	73.9000	ppm
Fe	32190.0	252.000	ppm
Co	170.000	67.8000	ppm
Ni	-13.0000	19.7000	ppm
Cu	38.0000	10.7000	ppm
Zn	139.000	10.1000	ppm
As	26.0000	6.56000	ppm
Se	-17.3000	3.82000	ppm
Sr	261.700	4.08000	ppm
Zr	161.900	2.20000	ppm
Mo	4.90000	1.05000	ppm
Hg	-35.6000	7.28000	ppm
Pb	28.0000	3.92000	ppm
Rb	118.000	3.91000	ppm
Cd	-44.0000	112.600	ppm
Sn	103.000	72.6000	ppm
Sb	-63.0000	36.9000	ppm
Ba	556.000	41.7000	ppm
Ag	44.0000	72.0000	ppm
U	6.40000	2.48000	ppm
Th	0.800000	1.52000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 12:03:38

ID: &lt;NIST-2709&gt;

( ) ( )

	Value	Std. dev.
CrHI	318.000	63.4000 ppm
K	27200.0	1430.00 ppm
Ca	21840.0	924.000 ppm
Ti	3540.00	416.000 ppm
CrLO	-99.0000	230.700 ppm
Mn	795.000	75.2000 ppm
Fe	32270.0	258.000 ppm
Co	101.000	67.8000 ppm
Ni	-30.0000	19.4000 ppm
Cu	17.0000	10.3000 ppm
Zn	142.000	10.2000 ppm
As	13.1000	6.79000 ppm
Se	-23.1000	3.77000 ppm
Sr	270.900	4.19000 ppm
Zr	167.800	2.27000 ppm
Mo	4.00000	1.06000 ppm
Hg	-12.6000	7.86000 ppm
Pb	42.6000	4.27000 ppm
Rb	116.100	3.90000 ppm
Cd	-55.0000	114.600 ppm
Sn	-13.0000	68.8000 ppm
Sb	-56.0000	38.1000 ppm
Ba	595.000	43.2000 ppm
Ag	-5.70000	70.9400 ppm
U	4.20000	2.45000 ppm
Th	4.70000	1.58000 ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994  
Meas Time: 7-DEC-1994 12:43:25  
ID: <C3\_1.0-1.5>  
( ) ( )

	Value	Std. dev.	
CrHI	77.0000	53.6000	ppm
K	12040.0	984.000	ppm
Ca	6200.00	509.000	ppm
Ti	4200.00	422.000	ppm
CrLO	54.0000	223.100	ppm
Mn	1059.00	73.5000	ppm
Fe	19070.0	168.000	ppm
Co	76.0000	51.4000	ppm
Ni	-66.0000	15.9000	ppm
Cu	30.7000	9.63000	ppm
Zn	123.600	9.35000	ppm
As	8.40000	6.58000	ppm
Se	-14.4000	3.51000	ppm
Sr	61.5000	1.98000	ppm
Zr	324.300	2.72000	ppm
Mo	2.10000	1.04000	ppm
Hg	-1.40000	7.18000	ppm
Pb	60.3000	4.30000	ppm
Rb	66.9000	3.04000	ppm
Cd	-18.0000	111.500	ppm
Sn	-4.40000	65.9400	ppm
Sb	26.0000	41.9000	ppm
Ba	212.000	26.7000	ppm
Ag	-52.0000	66.7000	ppm
U	9.80000	2.35000	ppm
Th	7.70000	1.68000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 13:04:09

ID: &lt;83\_1.0-2.0&gt;

( ) ( )

	Value	Std. dev.	
CrHI	366.000	65.5000	ppm
K	14800.0	1100.00	ppm
Ca	15060.0	757.000	ppm
Ti	8710.00	596.000	ppm
CrLO	250.000	280.000	ppm
Mn	2004.00	94.3000	ppm
Fe	27220.0	220.000	ppm
Co	97.0000	62.3000	ppm
Ni	70.0000	20.9000	ppm
Cu	165.000	13.3000	ppm
Zn	1525.00	23.8000	ppm
As	-201.000	25.4000	ppm
Se	-24.8000	4.17000	ppm
Sr	327.300	4.60000	ppm
Zr	333.200	3.15000	ppm
Mo	7.90000	1.25000	ppm
Hg	-22.9000	8.12000	ppm
Pb	2229.00	21.6000	ppm
Rb	79.6000	3.76000	ppm
Cd	-200.000	114.000	ppm
Sn	15.0000	73.1000	ppm
Sb	-7.80000	41.1700	ppm
Ba	681.000	46.4000	ppm
Ag	39.0000	75.8000	ppm
U	13.5000	2.58000	ppm
Th	20.8000	2.88000	ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994  
Meas Time: 7-DEC-1994 13:25:24  
ID: <A3\_1.5-2.0>  
( ) ( )

	Value	Std. dev.
CrHI	137.000	60.0000 ppm
K	23400.0	1330.00 ppm
Ca	9680.00	648.000 ppm
Ti	4310.00	429.000 ppm
CrLO	12.0000	225.500 ppm
Mn	1827.00	94.2000 ppm



Co	169.000	76.2000 ppm
Ni	-79.0000	19.4000 ppm
Cu	61.0000	11.4000 ppm
Zn	303.000	12.6000 ppm
As	4.80000	9.46000 ppm
Se	-22.6000	3.86000 ppm
Sr	71.1000	2.34000 ppm
Zr	341.000	3.11000 ppm



Mo	6.00000	1.22000 ppm
Hg	-17.0000	7.93000 ppm
Pb	184.800	6.68000 ppm
Rb	96.3000	3.74000 ppm
Cd	79.0000	132.900 ppm
Sn	-32.0000	77.6000 ppm
Sb	-5.50000	47.6600 ppm
Ba	233.000	30.3000 ppm
Ag	174.000	88.4000 ppm
U	5.60000	2.33000 ppm
Th	5.30000	1.67000 ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 13:47:06

ID: &lt;02-2-2.6&gt;

( ) ( )

	Value	Std. dev.
CrHI	109.000	53.9000 ppm
K	13700.0	1030.00 ppm
Ca	920.000	291.000 ppm
Ti	3050.00	356.000 ppm
CrLO	27.0000	193.600 ppm
Mn	450.000	63.0000 ppm
Fe	21820.0	180.000 ppm
Co	-43.0000	52.7000 ppm
Ni	-81.0000	15.3000 ppm
Cu	11.6000	8.98000 ppm
Zn	100.500	8.68000 ppm
As	8.10000	5.67000 ppm
Se	-24.3000	3.22000 ppm
Sr	49.7000	1.82000 ppm
Zr	354.500	2.84000 ppm
Mo	3.50000	1.05000 ppm
Hg	-26.8000	6.52000 ppm
Pb	27.6000	3.47000 ppm
Rb	67.7000	3.00000 ppm
Cd	-130.000	109.000 ppm
Sn	-76.0000	64.4000 ppm
Sb	-7.20000	39.0700 ppm
Ba	192.000	25.8000 ppm
Ag	67.0000	72.3000 ppm
U	7.60000	2.30000 ppm
Th	-1.10000	1.55000 ppm



Application:SOILS with U,Th,Ag Q044 05-27-1994

Meas Time: 7-DEC-1994 14:08:07

ID: &lt;01.2.0&gt;

( ) ( )

	Value	Std. dev.
CrHI	102.000	54.1000 ppm
K	13200.0	1020.00 ppm
Ca	1600.00	330.000 ppm
Ti	5010.00	424.000 ppm
CrLO	380.000	232.000 ppm
Mn	522.000	64.6000 ppm
Fe	16570.0	154.000 ppm
Co	19.0000	47.7000 ppm
Ni	-70.0000	15.4000 ppm
Cu	15.3000	9.15000 ppm
Zn	106.900	8.97000 ppm
As	6.60000	5.60000 ppm
Se	-14.5000	3.42000 ppm
Sr	63.2000	1.98000 ppm
Zr	470.100	3.32000 ppm
Mo	4.30000	1.13000 ppm
Hg	-9.10000	6.88000 ppm
Pb	20.0000	3.46000 ppm
Rb	55.9000	2.86000 ppm
Cd	-11.0000	114.700 ppm
Sn	-0.200000	68.3200 ppm
Sb	-24.0000	40.4000 ppm
Ba	201.000	26.3000 ppm
Ag	20.0000	71.9000 ppm
U	8.40000	2.33000 ppm
Th	4.50000	1.68000 ppm



Application:SOILS with U,Th,Ag 0044 05-27-1994

Meas Time: 7-DEC-1994 14:27:56

ID: &lt;&gt;

( ) ( )

	Value	Std. dev.	
CrHI	207.000	59.7000	ppm
K	25200.0	1380.00	ppm
Ca	23590.0	950.000	ppm
Ti	3330.00	415.000	ppm
CrLO	180.000	252.000	ppm
Mn	779.000	74.0000	ppm
Fe	32160.0	256.000	ppm
Co	133.000	67.9000	ppm
Ni	-44.0000	19.1000	ppm
Cu	52.0000	11.1000	ppm
Zn	144.000	10.3000	ppm
As	20.2000	6.76000	ppm
Se	-18.7000	3.85000	ppm
Sr	274.000	4.20000	ppm
Zr	167.900	2.26000	ppm
Mo	3.50000	1.05000	ppm
Hg	-23.3000	7.64000	ppm
Pb	37.0000	4.16000	ppm
Rb	119.100	3.93000	ppm
Cd	210.000	124.000	ppm
Sn	-8.90000	70.1100	ppm
Sb	32.0000	46.7000	ppm
Ba	607.000	43.8000	ppm
Ag	40.0000	74.0000	ppm
U	3.90000	2.46000	ppm
Th	2.70000	1.56000	ppm



**APPENDIX F**  
**XRF LOG ENTRIES**



Qualifier

December 7 1944 - Pyndium merung #2

6.50 - 6.26 = 0.24

spec ± 0.30 (OK)

.7 ND

0.0 ID

.1 -

.2 ID

0.4 ID

0.7 -

0.5 ID

1 ID

1 -

B ID

5 ID

0.6 ND

1 ND

0.6 ND

1 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

0.6 ND

Zero (OK)

runtime 1000 10 Fe 10 Am

Sample #

Hg Value Qualifier

NIST 2709

- 11.5

-

NIST 2709

- 18.3

-

A1 1.5-2.0

- 1.7

ND

A2 0-1.5

7.2

ND

B1 1.5-3.0

- 13.7

ND

C1 3.0-5.0

- 15.6

ND

B2 1.5-2.0

- 12.1

ND

NIST 2709

- 35.6

-

NIST 2709

- 12.6

-

C3 1.0-1.5

- 1.4

ND

B3 1.0-2.0

- 22.9

ND

D3 1.5-2.0

- 17.0

ND

D2 2-2.6

- 26.8

ND

D1 2.0

- 9.1

ND

NIST 2709

- 23.3

-

X 20.775

Om 7.87

HDL 23.6

MDL 78.7

MDL 78.7

MDL 78.7

MDL 78.7

MDL 78.7

MDL 78.7

MDL 78.7

MDL 78.7



## Pyridium Site 11 - XRF Data - 12/6/94

ID	TIME	Hg
G170-4 12	10.80	67 B
G170-6.5 13	11.38	U
E210-1.5 14	11.78	U
E90-7 15	12.19	U
D130-7 16	12.54	U
D190-2 17	13.49	U
B70-3 18	14.34	U
B130-1 19	14.74	U
BB-2 20	15.52	U
B160-1 21	15.86	U
UNKNOWN	16.51	U
G70-0.5 10	16.94	U
G70-1.5 11	17.28	168
DD-5.5 22	17.63	U

NIST2709	9.22	0
NIST2709	9.63	0
NIST2709	10.44	0
NIST2709	13.87	-17.1
NIST2709	15.10	-26.7
NIST2709	17.96	-21.1



Sample #

H<sub>g</sub> Value Qualifier

/	• D130-7	<del>22.2</del> -30.9	ND
/	D190-2	-38.0	ND
/	NIST 2709	-11.7	1
/	B70-3	-22.2	ND
/	B130 -1	-5.4	ND
/	NIST 2709	-24.7	1
/	B-B-2	-28.5	ND
/	B160-1	-21.1	ND
/	<del>DD-5.5 P (B)</del>		1
/	<del>DD 5.5 P (unknown)</del>	5.8	ND
/	G-70-0.5	0.5	ND
/	<del>G-70-0.5</del>	<del>1.68</del>	
/	TD 5.5	-18.6	ND
/	NIST 2709	-21.1	ND

December 7, 1994 - Indium mercury #2

Run time Cd-60 Fe-60 - Am-60

Ecal Th<sub>cor</sub> measured Specs

Cd104	Pb2 $\alpha$	10.54	10.552	$\pm 0.040$
	PbL $\beta$	12.61	12.629	$\pm 0.040$
	PbL $\gamma$	14.76	14.770	$\pm 0.040$
	Emmission PK	22.10	22.110	$\pm 0.040$
Fe 55	S-K $\alpha$	2.31	2.301	$\pm 0.010$
	Emmission PK	5.89	5.8940	$\pm 0.010$
Am 241	PbL $\alpha$	10.54	10.549	$\pm 0.050$
	PbL $\beta$	12.61	12.602	$\pm 0.050$
	Emmission PK	59.50	59.439	$\pm 0.20$

Res Ch12

max 2412

1/2 max 1206

R side (keV) 6.50

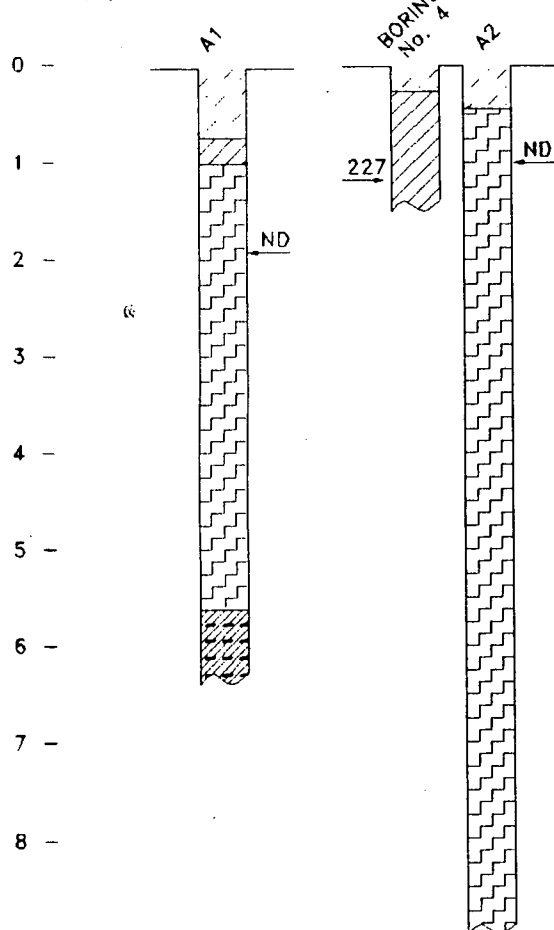
- L side (keV) 6.26








**APPENDIX G**  
**SOIL BORING CROSS SECTIONS**



DEPTH (ft)

**LEGEND:**

-  BROWN ORGANIC SILT
-  WASTE - WHITE CLAY-LIKE SOLID
-  BROWN COARSE TO MEDIUM SAND AND SILT
-  YELLOW BROWN SILT, FINE SAND AND CLAY
-  68 SAMPLE LOCATION AND MERCURY CONCENTRATION (mg/kg)
- ND NOT DETECTED

HORIZONTAL SCALE: 1" = 10'



Roy F. Weston, Inc.  
FEDERAL PROGRAMS DIVISION

IN ASSOCIATION WITH PRC ENVIRONMENTAL MANAGEMENT, INC.,  
C.C. JOHNSON & MALHOTRA, P.C., RESOURCE APPLICATIONS, INC.,  
R.E. SARRIERA ASSOCIATES, AND GRB ENVIRONMENTAL SERVICES, INC.

**FIGURE 1 - CROSS SECTION OF SAMPLE LINE A  
PYRIDIUM MERCURY DISPOSAL SITE No. 2  
HARRIMAN, NEW YORK  
DECEMBER 1994**

**US EPA REMOVAL ACTION BRANCH**  
SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM  
CONTRACT# 68-W5-0019

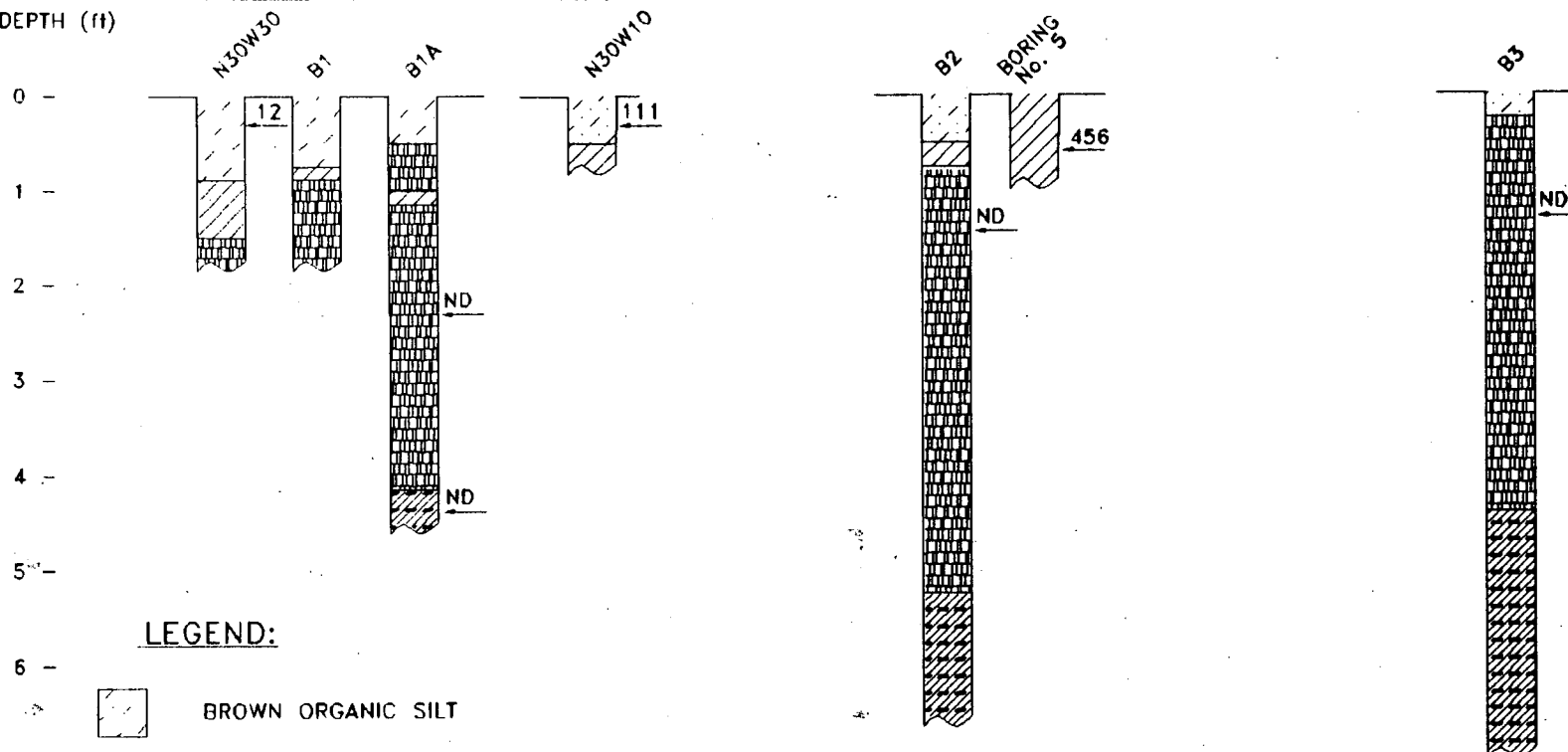
DRW BY: J. HAMPTON JR.

EPA TASK MONITOR: E. WILSON

START PROJECT MANAGER: K. CAMPBELL



DEPTH (ft)

**LEGEND:**

- 6 - BROWN ORGANIC SILT
- 7 - WASTE - WHITE CLAY-LIKE SOLID
- 8 - YELLOW BROWN SILT, FINE SAND AND CLAY
- FILL MIXED WITH CONSTRUCTION DEBRIS, COAL, AND WHITE FLAKES
- 68 SAMPLE LOCATION AND MERCURY CONCENTRATION (mg/kg)
- ND NOT DETECTED

HORIZONTAL SCALE: 1" = 10'

**FIGURE 2 - CROSS SECTION OF SAMPLE LINE B  
PYRIDIUM MERCURY DISPOSAL SITE No. 2  
HARRIMAN, NEW YORK  
DECEMBER 1994**

**US EPA REMOVAL ACTION BRANCH**  
SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM  
CONTRACT# 68-W5-0019

DRW BY: J. HAMPTON JR.

EPA TASK MONITOR: E. WILSON

START PROJECT MANAGER: K. CAMPBELL



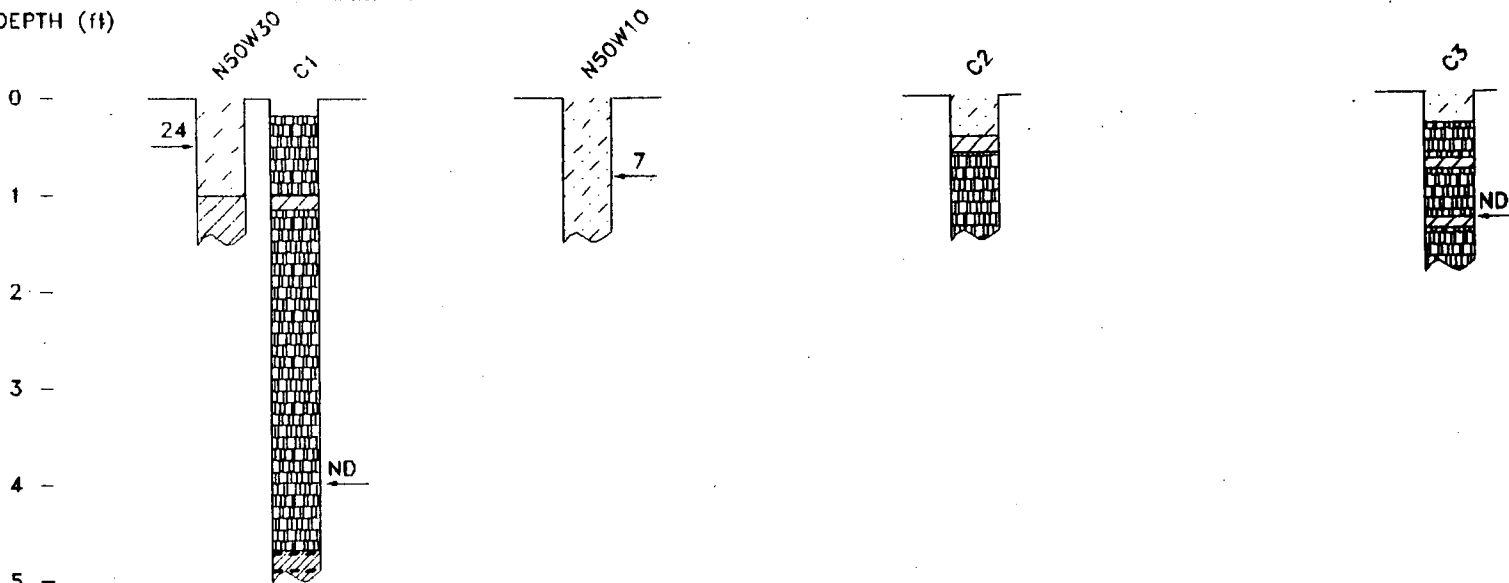
Roy F. Weston, Inc.  
FEDERAL PROGRAMS DIVISION

IN ASSOCIATION WITH PRC ENVIRONMENTAL MANAGEMENT, INC.,  
C.C. JOHNSON & MALHOTRA, P.C., RESOURCE APPLICATIONS, INC.,  
R.E. SARRIERA ASSOCIATES, AND GRB ENVIRONMENTAL SERVICES, INC.








PM2-1.3119

DEPTH (ft)



**LEGEND:**

- 6 -  BROWN ORGANIC SILT
- 7 -  WASTE - WHITE CLAY-LIKE SOLID
- 8 -  YELLOW BROWN SILT, FINE SAND AND CLAY
-  FILL MIXED WITH CONSTRUCTION DEBRIS, COAL, AND WHITE FLAKES
-  68 SAMPLE LOCATION AND MERCURY CONCENTRATION (mg/kg)
- ND NOT DETECTED

HORIZONTAL SCALE: 1" = 10'

**FIGURE 3 - CROSS SECTION OF SAMPLE LINE C  
PYRIDIUM MERCURY DISPOSAL SITE No. 2  
HARRIMAN, NEW YORK  
DECEMBER 1994**

**US EPA REMOVAL ACTION BRANCH**  
SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM  
CONTRACT# 68-W5-0019

DRW BY: J. HAMPTON JR.

EPA TASK MONITOR: E. WILSON

START PROJECT MANAGER: K. CAMPBELL

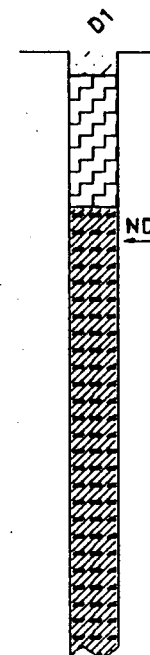
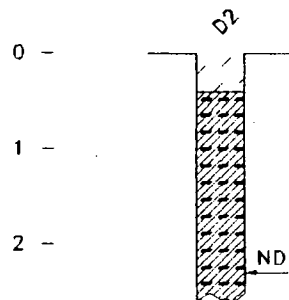


Roy F. Weston, Inc.  
FEDERAL PROGRAMS DIVISION

IN ASSOCIATION WITH PRC ENVIRONMENTAL MANAGEMENT, INC.,  
C.C. JOHNSON & MALHOTRA, P.C., RESOURCE APPLICATIONS, INC.,  
R.E. SARRIERA ASSOCIATES, AND GRB ENVIRONMENTAL SERVICES, INC.



DEPTH (ft)



**LEGEND:**



BROWN ORGANIC SILT



WASTE - WHITE CLAY-LIKE SOLID



YELLOW BROWN SILT, FINE SAND AND CLAY



BROWN COARSE TO MEDIUM SAND AND SILT

68

SAMPLE LOCATION AND MERCURY CONCENTRATION (mg/kg)

ND

NOT DETECTED

HORIZONTAL SCALE: 1" = 10'

**FIGURE 4 - CROSS SECTION OF SAMPLE LINE D  
PYRIDIUM MERCURY DISPOSAL SITE No. 2  
HARRIMAN, NEW YORK  
DECEMBER 1994**

**US EPA REMOVAL ACTION BRANCH**  
SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM  
CONTRACT# 88-W5-0019

DRW BY: J. HAMPTON JR.

EPA TASK MONITOR: E. WILSON

START PROJECT MANAGER: K. CAMPBELL



**Roy F. Weston, Inc.**  
**FEDERAL PROGRAMS DIVISION**

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**APPENDIX H**

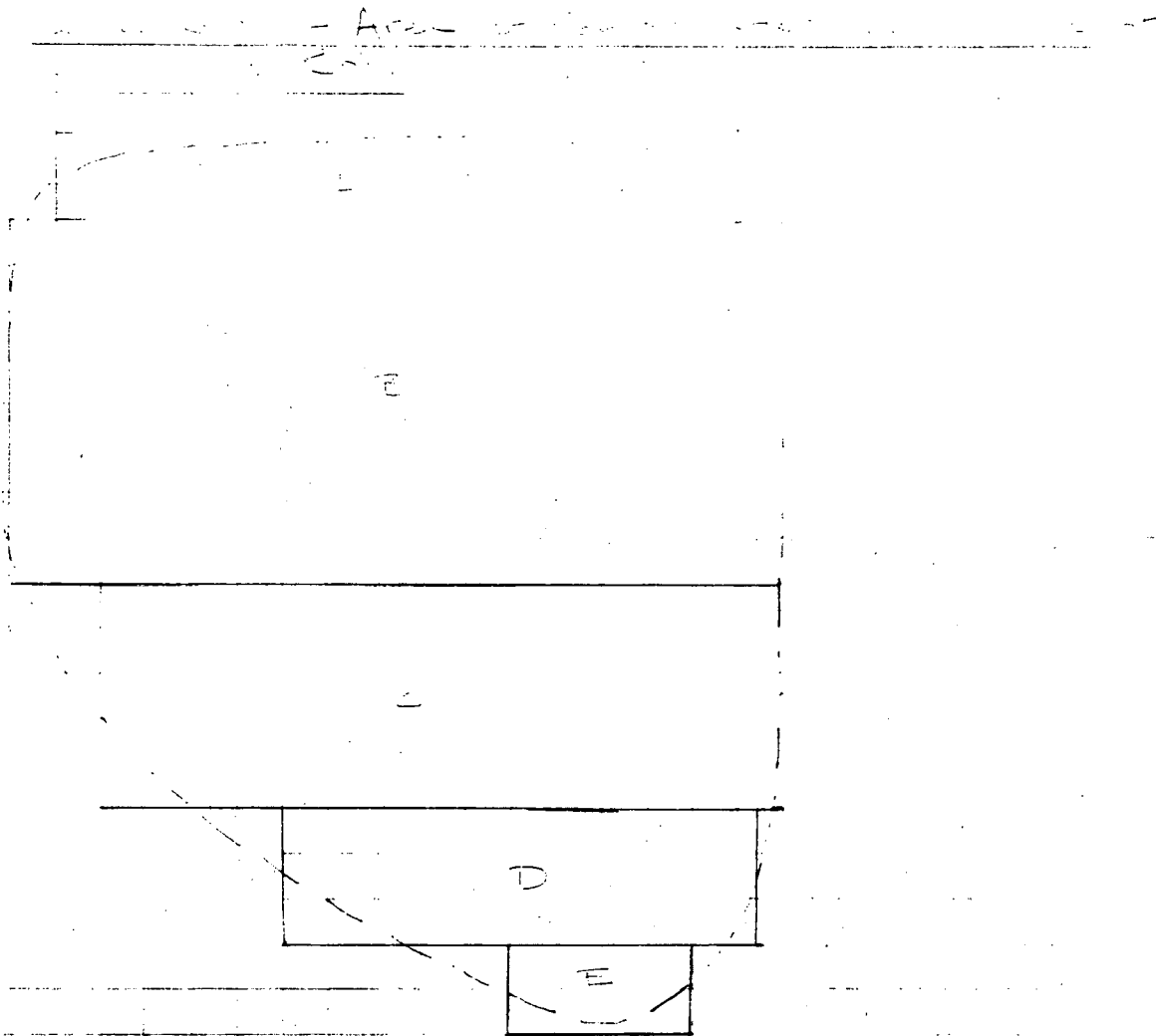
**CALCULATIONS OF  
AREA OF CONTAMINATION AND  
VOLUME OF CONTAMINATED SOIL**



CLIENT/SUBJECT \_\_\_\_\_ W.O. NO. \_\_\_\_\_

TASK DESCRIPTION Basin Map - Dredging TASK NO. \_\_\_\_\_

PREPARED BY _____	DEPT _____	DATE _____	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">APPROVED BY _____</div> <div style="border: 1px solid black; padding: 5px;">DEPT _____ DATE _____</div>
MATH CHECK BY _____	DEPT _____	DATE _____	
METHOD REV. BY _____	DEPT _____	DATE _____	



Dashed line indicates extent of contamination from Figure 2. Solid lines indicate sections used in area calculation. Scale 1 inch = 20 feet

Area of contamination = Sum of sections A through E

$$\text{Area A} = L_A \times W_A = 3.5 \text{ in} \times 0.5 \text{ in} \left( \frac{400 \text{ ft}^2}{\text{in}^2} \right) = 700 \text{ ft}^2$$



CLIENT/SUBJECT _____			W.O. NO. _____							
TASK DESCRIPTION <u>Permeable Paving</u>			TASK NO. _____							
PREPARED BY _____	DEPT _____	DATE _____	<table border="1" style="width: 100%;"> <tr> <td colspan="2" style="text-align: center;">APPROVED BY</td> </tr> <tr> <td colspan="2" style="height: 40px;"> </td> </tr> <tr> <td>DEPT _____</td> <td>DATE _____</td> </tr> </table>		APPROVED BY				DEPT _____	DATE _____
APPROVED BY										
DEPT _____	DATE _____									
MATH CHECK BY _____	DEPT _____	DATE _____								
METHOD REV. BY _____	DEPT _____	DATE _____								

$$Area A = L_A \times W_A = 1.5m \times 0.22m \times \frac{1000^2}{m^2} = 325 ft^2$$

$$Area B = L_B \times W_B = 1.5m \times 0.75m \times \frac{1000^2}{m^2} = 1125 ft^2$$

$$Area E = L_E \times W_E = 1.0m \times 0.5m \times \frac{1000^2}{m^2} = 1000 ft^2$$

$$\begin{aligned}
 \text{Area of Contamination} &= \text{Sum of Areas A, B, E, F, G} \\
 &= 325 ft^2 + 1125 ft^2 + 1000 ft^2 + 1750 ft^2 + 200 ft^2 \\
 &= 4400 ft^2
 \end{aligned}$$

Volume of Contaminated Soil = Area x Depth

Assume a depth of contamination of 2 feet throughout

$$Volume = 4400 ft^2 (2 ft) \times \frac{1 \text{ cubic yard}}{27 ft^3}$$

$$= 162 \text{ cubic yards}$$

say 500 cubic yards



**APPENDIX I**

**NIST CERTIFICATE OF ANALYSIS  
FOR STANDARD REFERENCE MATERIAL 2709**





# National Institute of Standards & Technology

## Certificate of Analysis

### Standard Reference Material 2709

San Joaquin Soil

#### Baseline Trace Element Concentrations

This Standard Reference Material (SRM) is intended primarily for use in the analysis of soils, sediments, or other materials of a similar matrix. SRM 2709 is an agricultural soil that was oven-dried, sieved, and blended to achieve a high degree of homogeneity. A unit of SRM 2709 consists of 50 g of the dried material.

The certified elements for SRM 2709 are given in Table 1. The values are based on measurements using one definitive method or two or more independent and reliable analytical methods. Noncertified values for a number of elements are given in Table 2 as additional information on the composition. The noncertified values should not be used for calibration or quality control. Analytical methods used for the characterization of this SRM are given in Table 3 along with analysts and cooperating laboratories. All values (except for carbon) are based on measurements using a sample weight of at least 250 mg. Carbon measurements are based on 100-mg samples.

#### NOTICE AND WARNINGS TO USERS

**Expiration of Certification:** This certification is valid for 5 years from the date of shipment from NIST. Should any of the certified values change before the expiration of the certification, purchasers will be notified by NIST. Return of the attached registration card will facilitate notification.

**Stability:** This material is considered to be stable; however, its stability has not been rigorously assessed. NIST will monitor this material and will report any substantive changes in certification to the purchaser.

**Use:** A minimum sample weight of 250 mg (dry weight - see Instructions for Drying) should be used for analytical determinations to be related to the certified values on this Certificate of Analysis.

To obtain the certified values, sample preparation procedures should be designed to effect complete dissolution. If volatile elements (i.e., Hg, As, Se) are to be determined, precautions should be taken in the dissolution of SRM 2709 to avoid volatilization losses.

Statistical consultation was provided by S.B. Schiller of the NIST Statistical Engineering Division.

The overall direction and coordination of the analyses were under the chairmanship of M.S. Epstein and R.L. Watters, Jr., of the NIST Inorganic Analytical Research Division.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Standard Reference Materials Program by T.E. Güls and J.S. Kane.

Gaithersburg, MD 20899  
October 30, 1992

William P. Reed, Chief  
Standard Reference Materials Program

(over)



Instructions for Drying: When nonvolatile elements are to be determined, samples should be dried for 2 h at 110 °C. Volatile elements (i.e., Hg, As, Se) should be determined on samples as received; separate samples should be dried as previously described to obtain a correction factor for moisture. Correction for moisture is to be made to the data for volatile elements before comparing to the certified values. This procedure ensures that these elements are not lost during drying. The weight loss on drying has been found to be in the range of 1.8 to 2.5 %.

Source and Preparation of Material: The U.S. Geological Survey (USGS), under contract to the NIST, collected and processed the material for SRM 2709. The soil was collected from a plowed field, in the central California San Joaquin Valley, at Longitude 121° 25' and Latitude 36° 55'. The collection site is in the Panoche fan between the Panoche and Cantu creek beds. The top 7.5-13 cm (3-5 in) of soil containing sticks and plant debris was removed, and the soil was collected from the 13 cm level down to a depth of 46 cm (18 in) below the original surface. The material was shoveled into 0.114 m<sup>3</sup> (30-gal) plastic buckets and shipped to the USGS laboratory for processing.

The material was spread on 30.5 cm x 61 cm (1 ft x 2 ft) polyethylene-lined drying trays in an air drying oven and dried for three days at room temperature. The material was then passed over a vibrating 2-mm screen to remove plant material, rocks, and large chunks of aggregated soil. Material remaining on the screen was deaggregated and rescreened. The combined material passing the screen was ground in a ball mill to pass a 74- $\mu$ m screen and blended for 24 h. Twenty grab samples were taken and measured for the major oxides using x-ray fluorescence spectrometry and for several trace elements using inductively coupled plasma atomic emission analysis to provide preliminary assessment of the homogeneity of the material prior to bottling. The material was bottled into 50-g units and randomly selected bottles were taken for the final homogeneity testing.

Analysis: The homogeneity, using selected elements in the bottled material as indicators, was assessed using x-ray fluorescence spectrometry and neutron activation analysis. In a few cases, statistically significant differences were observed, and the variance due to material inhomogeneity is included in the overall uncertainties of the certified values. The estimated relative standard deviation for material inhomogeneity is less than 1 % for those elements for which homogeneity was assessed.

Certified Values and Uncertainties: The certified values are weighted means of results from two or more independent analytical methods, or the mean of results from a single definitive method, except for mercury. Mercury certification is based on cold vapor atomic absorption spectrometry used by two different laboratories employing different methods of sample preparation prior to measurement. The weights for the weighted means were computed according to the iterative procedure of Paule and Mandel (NBS Journal of Research 87, 1982, pp. 377-385). The stated uncertainty includes allowances for measurement imprecision, material variability, and differences among analytical methods. Each uncertainty is the sum of the half-width of a 95 % prediction interval and includes an allowance for systematic error among the methods used. In the absence of systematic error, a 95 % prediction interval predicts where the true concentrations of 95 % of the samples of this SRM lie.



Table 1. Certified Values

<u>Element</u>	<u>wt. %</u>		<u>Element</u>	<u>μg/g</u>	
Aluminum	7.50	= 0.06	Antimony	7.9	= 0.6
Calcium	1.89	= 0.05	Arsenic	17.7	= 0.8
Iron	3.50	= 0.11	Barium	968	= 40
Magnesium	1.51	= 0.05	Cadmium	0.38	= 0.01
Phosphorus	0.062	= 0.005	Chromium	130	= 4
Potassium	2.03	= 0.06	Cobalt	13.4	= 0.7
Silicon	29.66	= 0.23	Copper	34.6	= 0.7
Sodium	1.16	= 0.03	Lead	18.9	= 0.5
Sulfur	0.089	= 0.002	Manganese	538	= 17
Titanium	0.342	= 0.004	Mercury	1.40	= 0.08
			Nickel	88	= 5
			Selenium	1.57	= 0.08
			Silver	0.41	= 0.03
			Strontium	231	= 2
			Thallium	0.74	= 0.05
			Vanadium	112	= 5
			Zinc	106	= 3

**Noncertified Values:** Noncertified values, shown in parentheses, are provided for information only. An element concentration value may not be certified if a bias is suspected in one or more of the methods used for certification, or if two independent methods are not available. Certified values for some of these elements will eventually be provided in a revised certificate when more data is available.

Table 2. Noncertified Values

<u>Element</u>	<u>wt. %</u>	<u>Element</u>	<u>μg/g</u>
Carbon	(1.2)	Cerium	(42)
		Cesium	(5.3)
		Dysprosium	(3.5)
		Europium	(0.9)
		Gallium	(14)
		Gold	(0.3)
		Hafnium	(3.7)
		Holmium	(0.54)
		Iodine	(5)
		Lanthanum	(23)
		Molybdenum	(2.0)
		Neodymium	(19)
		Rubidium	(96)
		Samarium	(3.8)
		Scandium	(12)
		Thorium	(11)
		Tungsten	(2)
		Uranium	(3)
		Ytterbium	(1.6)
		Yttrium	(18)
		Zirconium	(160)



Table 3. Analytical Methods Used for the Analysis of SRM 2709

<u>Element</u>	<u>Certification Methods</u>	<u>Element</u>	<u>Certification Methods</u>
Ag	ID ICPMS; RNAA	Mo	ID ICPMS
Al	XRF1; XRF2; INAA; DCP; ICP	Na	INAA; FAES; ICP
As	RNAA; HYD AAS; INAA	Nd	ICP
Au	INAA; FAAS	Ni	ID ICPMS; ETAAS; INAA
Ba	XRF2; FAES	P	DCP; COLOR; XRF2
C	COUL	Pb	ID TIMS
Ca	XRF1; XRF2; DCP	Rb	INAA
Cd	ID ICPMS; RNAA	S	ID TIMS
Ce	INAA; ICP	Sb	INAA; ETAAS
Co	INAA; ETAAS; ICP	Sc	INAA; ICP
Cr	INAA; DCP; ICP	Se	RNAA; HYD AAS
Cs	INAA	Si	XRF1; XRF2; GRAV
Cu	RNAA; FAES; ICP	Sm	INAA
Dy	INAA	Sr	ID TIMS; INAA; ICP
Eu	INAA	Th	ID TIMS; INAA; ICP
Fe	XRF1; XRF2; INAA; DCP	Ti	INAA; XRF1; XRF2; DCP
Ga	INAA; ICP	Tl	ID TIMS; LEAFS
Hf	INAA	U	ID TIMS; INAA
Hg	CVAAS	V	INAA; ICP
Ho	INAA	W	INAA
I	INAA	Y	ICP
K	XRF1; XRF2; FAES; ICP; INAA	Yb	INAA
La	INAA; ICP	Zn	ID TIMS; ICP; INAA; POLAR
Mg	INAA; XRF1; ICP	Zr	INAA
Mn	INAA; ICP		

\*Methods in bold were used to corroborate certification methods or to provide information values.

ID TIMS - Isotope dilution thermal ionization mass spectrometry; mixed acid digestion.

ID ICPMS - Isotope dilution inductively coupled plasma mass spectrometry; mixed acid digestion.

INAA - Instrumental neutron activation analysis.

RNAA - Radiochemical neutron activation analysis; mixed acid digestion.

XRF1 - Wavelength dispersive x-ray fluorescence on fused borate discs.

XRF2 - Wavelength dispersive x-ray fluorescence spectrometry on pressed powder.

ICP - Inductively coupled plasma atomic emission spectrometry; mixed acid digestion.

DCP - Direct current plasma atomic emission spectrometry; lithium metaborate fusion.

ETAAS - Electrothermal atomic absorption spectrometry; mixed acid digestion.

CVAAS - Cold vapor atomic absorption spectrometry.

HYD AAS - Hydride generation atomic absorption spectrometry.

FAAS - Flame atomic absorption spectrometry; mixed acid digestion except for Au, leached with HBr-Br<sub>2</sub>.

FAES - Flame atomic emission spectrometry; mixed acid digestion.

COLOR - Colorimetry; lithium metaborate fusion.

GRAV - Gravimetry; sodium carbonate fusion.

COUL - Combustion coulometry.

LEAFS - Laser enhanced atomic fluorescence spectrometry; mixed acid digestion.

POLAR - Polarography.



# HEALTH CONSULTATION

## **PYRIDIDIUM MERCURY DISPOSAL SITE #2**

**Orange County**

**Harriman, New York**

**CERCLIS NO. NY0000162850**

**August 28, 1995**

---

**Prepared By**

**New York State Department of Health**

**Under Cooperative Agreement With**

**U.S. Department of Health & Human Services**

**Public Health Service**

**Agency for Toxic Substances and Disease Registry**



**HEALTH CONSULTATION**

**PYRIDIDIUM MERCURY DISPOSAL SITE #2  
HARRIMAN, ORANGE COUNTY, NEW YORK  
CERCLIS NO. NY000162850**

**August 28, 1995**

**Prepared by:**

**New York State Department of Health  
Under a Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry**



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## BACKGROUND AND STATEMENT OF ISSUE

The New York State Department of Health (NYS DOH) through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) has reviewed information and analytical data from the Pyridium Mercury Disposal Site #2 to determine if there is a public health threat associated with exposure to mercury. The Pyridium Mercury Disposal Site #2 (Figure 1) is located on a residential lot along South Main Street in the Village of Harriman, Town of Monroe, Orange County, near the intersection of Routes 17M (Ramapo Avenue) and South Main Street. Site #2 is within one-quarter mile of Pyridium Site #1, the trailer park (Figure 2). The area of concern (Figure 3), which is about one-quarter acre in size, includes an old farmhouse built in the late 1800's that pre-dates the waste disposal activities. This property is bounded to the northwest by an overgrown lot, to the southwest by a gasoline service station, to the southeast by Ramapo Lane and to the northeast by South Main Street. The two-story house has been occupied for approximately three years by a mother with two children, ages six (son) and seven (daughter). Five days each week, three hours each day, a home health aide visits the family. Access to the basement, used only for storage, is from the outside. The stone-walled basement has a concrete floor and is primarily dry throughout the year. According to a local resident, eight to fifteen truckloads of waste materials, a mercuric or mercurous salt generated during the production of niacinamide (vitamin B-3) by the former Pyridium Corporation, were observed to have been dumped during the early 1950's in an "L" shape, down and across the front yard.

On October 21, 1994, the NYS DOH assisted the Village of Harriman Code Enforcement Officer in investigating a report of a possible second disposal site. Test holes were dug with the assistance of the property owner and the Code Enforcement Officer. A Nepera, Inc., official was present during this preliminary investigation. Whitish-gray, Pyridium-like wastes were discovered a few inches below the ground surface at several locations in the front yard. Surface wastes were observed only where a large tree root broke through the grass cover.

On October 26, 1994, at the request of the NYS DOH, the United States Environmental Protection Agency (US EPA) collected one surface soil sample (0-1 inch below ground surface), two subsurface soil samples (0-3 inches below ground surface) and two subsurface waste samples (3-6 inches and 1-6 inches below ground surface). The two subsurface waste samples had significantly elevated levels of mercury (227 and 456 milligrams of total mercury per kilogram of soil [mg/kg]). The surface soil sample collected within the fenced yard, where the two children and family dog spend much of their play time, contained 27.5 mg/kg of total mercury. Mercury is typically found in soils at levels less than 1 mg/kg.



On October 29, 1994, the US EPA collected nine additional surface soil samples (0 to 3 inches below any vegetative cover) to further assess the extent of surface contamination so that appropriate public health decisions could be made. Total mercury levels ranged from 0.1 to 117 mg/kg with an average of 35.1 mg/kg. Mercury contamination appears to increase markedly from the front porch of the home outward toward the reported area of waste disposal. Based on field observations, less obvious mercury contamination in surface soils within the fenced play area may be the result of the family's pet repeatedly digging in the yard.

Based on the results of laboratory testing (speciation) of a waste sample collected from the original Pyridium Mercury Disposal Site #1 (trailer park) and the similar appearance of these wastes, it is presumed that the mercury found in the soils at site #2 is inorganic in nature.

Residents rely on the Village of Harriman municipal water supply for drinking water. These wells are not near the site. The village water is regularly monitored to ensure that it meets the NYS DOH drinking water standards for public water supplies. The service connection from the watermain to the house does not pass through buried waste materials. Entry of contaminants into the buried water pipes is unlikely. Should there be a crack, break, breach, or compromise in the integrity of the waterline piping, positive pressure within the pipes would force water out rather than allow contaminants to seep in. A major break in a waterline would be readily noticed by residents through a loss of water at the tap and by discolored (i.e., dirty) water.

#### DISCUSSION

Mercury is present at higher than normal background levels in surface soil and surface wastes at the Pyridium Mercury Disposal Site #2. Exposure to mercury in surface soil and surface waste may occur via accidental ingestion (eating) of soil and dust, eating of garden fruits and vegetables grown in contaminated soils, skin contact or breathing of mercury contaminated dust or vapor. Children generally eat greater amounts of soil and dust than adults. This is especially true for preschoolers because they tend to put their hands or fingers in their mouths or for children with pica (an unreasonable craving), in this case, for soil. Those children who repeatedly handle the waste material extensively would have a greater likelihood of ingesting the mercury waste which could stick to their hands. Mercury contaminated soil can also be tracked into the home on shoes and left on floors and surfaces where people could come in contact with it. A family pet, such as a dog or cat, can walk through, dig into, lie upon, or roll over contaminated soils and carry mercury contamination into the home on its paws and/or fur. Indirect exposure for an infant can occur



from eating contaminated breast milk if the mother was exposed to mercury.

Long-term exposure to sufficiently high levels of mercury can damage the kidneys, nervous system and developing fetus (baby). The most sensitive target organ for low-level inorganic mercury exposure appears to be the kidneys.

Health risk comparison values are used to assess if further evaluation of the soil is needed. Several factors are considered in the evaluation including soil ingestion rate, the size and age of the exposed individual, length of exposure and the health effects data. A health comparison value for mercury in soil is the mercury concentration in soil which would provide, by ingestion, a dose of mercury equal to the daily exposure below which adverse health effects are unlikely to occur. A contaminant at concentrations exceeding a health comparison value does not necessarily mean that either exposure to the contaminant or adverse health effects have occurred or will occur.

Health comparison values are developed assuming worst case exposure, i.e., the greatest exposure possible. Using soil ingestion rates for children with pica overestimates soil ingestion rates for the general public, including most children.

Soil mercury concentrations identified at the site range from 0.1 to 456 mg/kg. Table 1 (Appendix B) contains soil health comparison values for inorganic mercury. The soil mercury concentrations at the site exceed some of the health comparison values. Therefore, the soil concentrations of mercury at the Pyridium Mercury Waste Disposal Site #2 warrant further characterization and evaluation of exposure pathways and the potential for adverse health effects in individuals who may have been exposed to the waste materials.

A child with pica is likely to have the highest exposure and, based on the highest soil mercury concentration (456 ppm), is at high risk of having adverse kidney effects. Children without pica and adults are at minimal risk of having adverse kidney effects. Fruits and vegetables grown in contaminated soil are an additional potential source of exposure. Mercury levels are higher in plants grown in contaminated soil than in those grown in soil which is not contaminated. Eating such plants could contribute additional mercury to the diet.

The soil mercury concentrations at the site provide a source for exposure which could produce health effects in individuals whose activities lead to greater contact with the waste material.

On June 9, 1995, the NYS DOH sent copies of this health consultation to interested parties requesting concerns and comments



on the report by July 13, 1995. The NYS DOH received one comment; the response is in Appendix D.

### CONCLUSIONS

Based on the information reviewed, the NYS DOH in consultation with ATSDR concludes the following:

1. Based on ATSDR's present public health hazard category classification (Appendix C), the Pyridium Mercury Disposal Site #2 is a public health hazard because inorganic mercury is present in soil at concentrations which may cause adverse health effects. Residents, particularly preschool children who may eat unusual amounts of contaminated soil and residents eating vegetables grown in the contaminated soil, are at risk of kidney damage due to the mercury contamination at the Pyridium Mercury Disposal Site #2.
2. At a minimum, exposure to inorganic mercury may have occurred via dermal contact based on discussions with the tenant and on field observations.
3. The nature and extent of contamination at this site has not been completely characterized. Contamination other than inorganic mercury may be present within subsurface fill materials.

### RECOMMENDATIONS

1. Measures should be taken to prevent exposures to front yard soils which contain the mercury wastes. Temporary measures are needed to allow for the residents' daily activities. This action has been completed by the US EPA.
2. The nature and extent of contamination at the site should be completely characterized. A comprehensive analysis of the wastes should be performed. Sampling of soils and wastes should extend outward and downward to determine areas requiring future remedial actions. Subsurface investigations might potentially identify other types of chemical wastes used as fill or find buried drums.
3. The company or agency that performs the additional environmental sampling should work with the NYS DOH so that sample design and detection levels are appropriate for making public health decisions.
4. Impose deed restrictions on the property, in the absence of waste removal, to prevent possible disturbance and contact with buried wastes.



5. During future site clean-up involving excavation, site residents should be temporarily relocated or precautionary measures taken to minimize potential exposures or personal injuries.

#### HEALTH ACTIVITIES RECOMMENDATION PANEL (HARP) RECOMMENDATIONS

The data and information developed in the Health Consultation for the Pyridium Mercury Disposal Site #2, Harriman, New York, has been reviewed by ATSDR's Health Activities Recommendation Panel (HARP) to determine appropriate follow-up health actions. Because of past and possible current exposure to mercury-contaminated residential soils, the panel recommended this site for follow-up health activities. Specifically, those persons exposed should be medically evaluated for the presence of mercury. In addition, the HARP also determined that community health and health professions education are indicated. The NYS DOH has and will continue to conduct site-specific education activities at the site.

#### PUBLIC HEALTH ACTIONS

##### Public Health Actions Taken

1. The NYS DOH held a public availability session on November 28, 1994, to provide information to the community about the site and address health-related concerns.
2. A NYS DOH physician talked with the adult resident (mother) about health concerns related to the site.
3. Urine sampling was offered; whether or not this offer was accepted and any results which might have been obtained are confidential under New York State law.
4. In response to a recommendation by the NYS DOH, the US EPA blocked off the fenced, front yard play area to prevent the family dog from potentially digging up contaminated soils. The US EPA also erected a new fenced-in play area in the back yard where no soil contamination was detected.

##### Public Health Actions Planned

1. If authorized, waste removal may occur in summer or fall of 1995. The three residents and dog may be temporarily relocated by the US EPA should excavation of contaminated soil occur.
2. The NYS DOH will review all site-related investigation reports and health-related information and, if necessary, hold



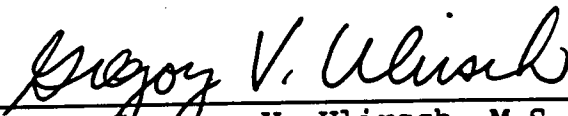
additional public meetings to keep the community informed of activities at the site.

3. The NYS DOH will continue to investigate reports of the existence of other similar sites in the community.



## CERTIFICATION

The Health Consultation for the Pyridium Mercury Disposal Site #2 was prepared by the New York State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.



Gregory V. Ulirsch, M.S.  
Technical Project Officer  
Superfund Site Assessment Branch (SSAB)  
Division of Health Assessment and Consultation (DHAC)  
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation, and concurs with its findings.



for Sharon Williams-Fleetwood, Ph.D.  
Chief, SSAB, DHAC, ATSDR



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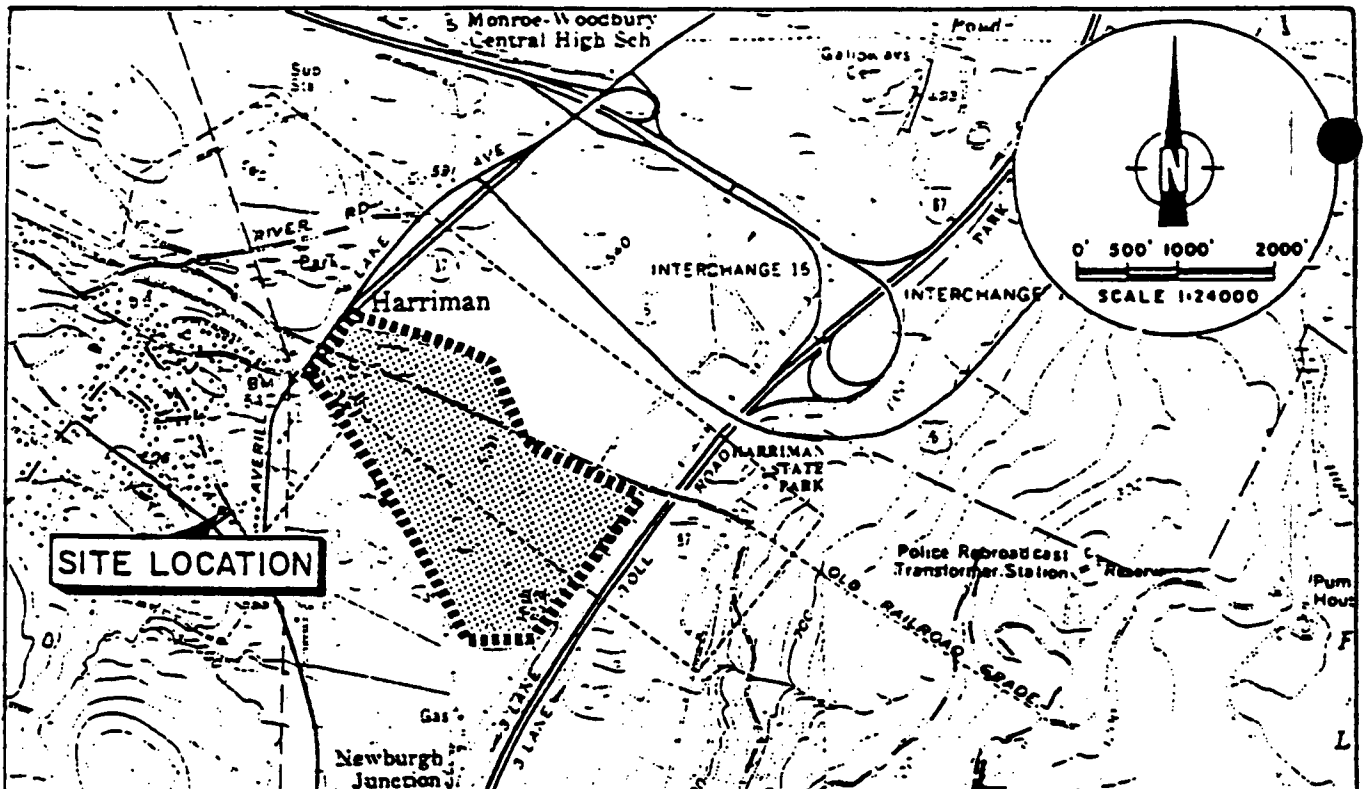
World Health Organization (WHO). 1990. Environmental Health Criteria 101. Geneva, Switzerland. World Health Organization Distribution and Sales Service. International Programme on Chemical Safety.



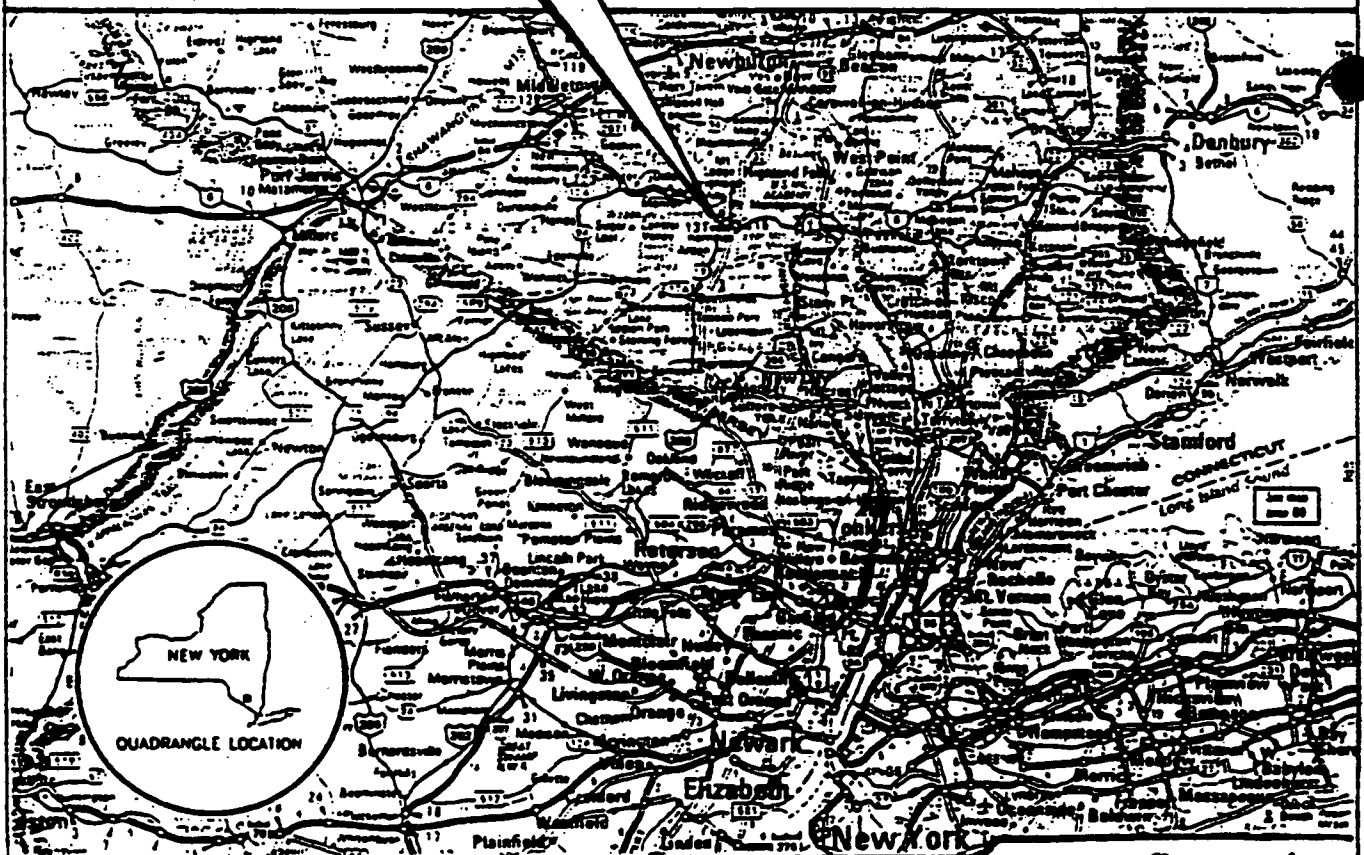
**APPENDIX A**

**Figures**





SOURCE: U.S.G.S. MONROE, N.Y. AND POPOLOPEN LAKE QUADRANGLE  
41074 - C2 - TF-024 AND N4115 - W 7400 / 7.5



SOURCE: RAND McNALLY ROAD ATLAS

figure 1  
SITE LOCATION  
HARRIMAN, NEW YORK



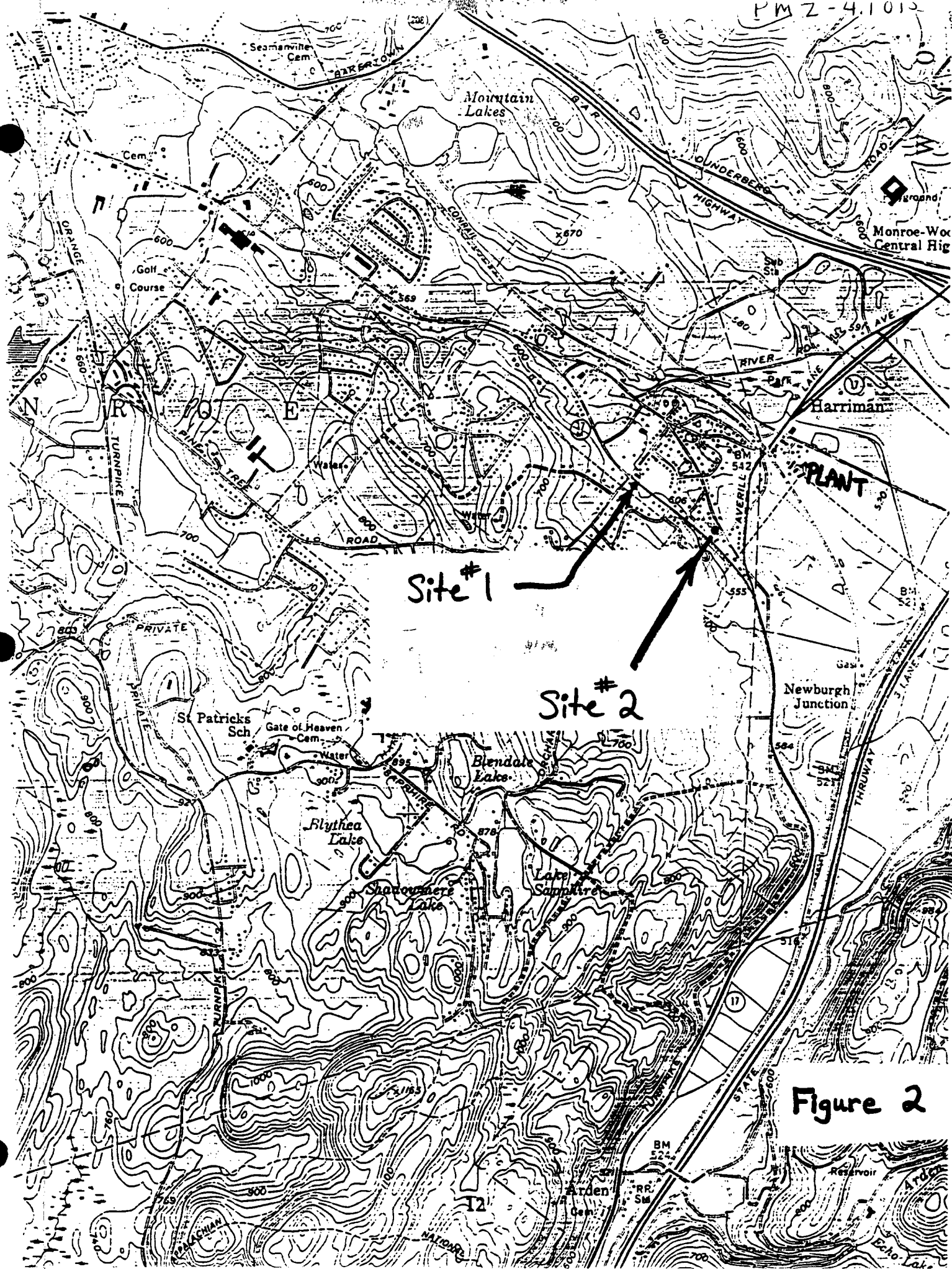
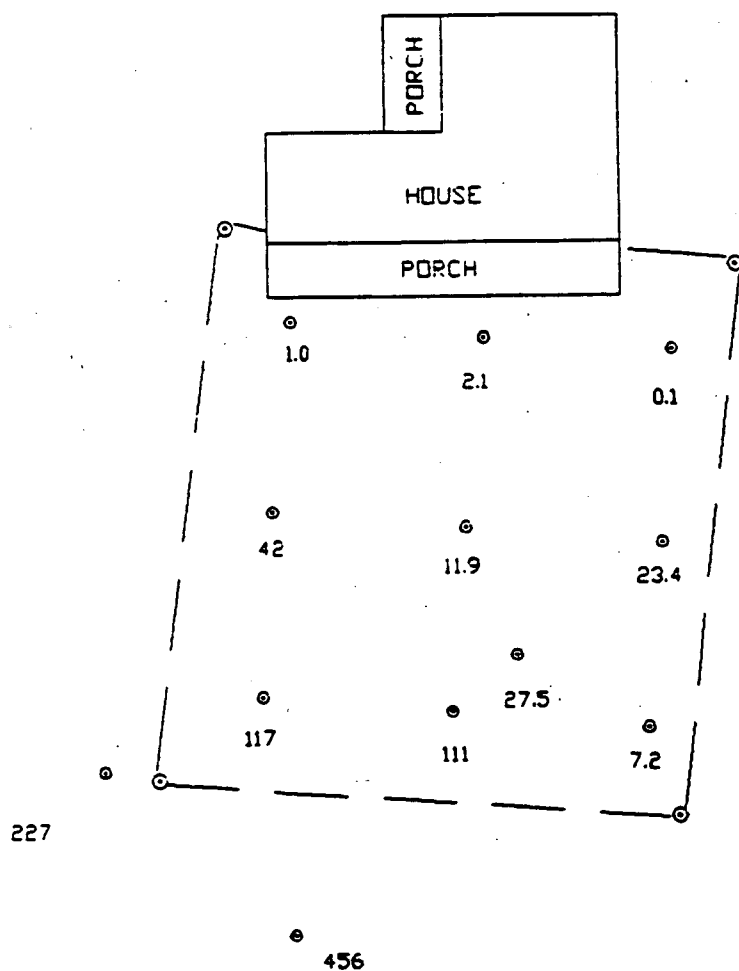


Figure 2



0.1

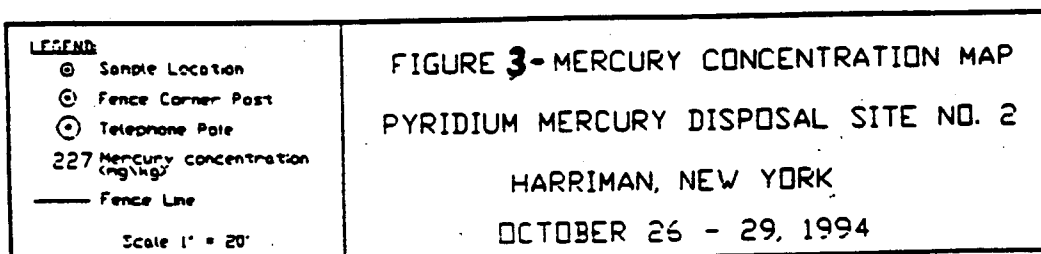


227

0.2

⊙ Pole #133

⊙ Pole #132





**APPENDIX B**

**Tables**



Table 1. SOIL COMPARISON VALUES FOR RESIDENTIAL EXPOSURE TO INORGANIC MERCURY

Duration of Exposure:	COMPARISON VALUE				
	Ingestion of Soil			Soil and Homegrown Produce***	
	Pica Child <sup>1</sup>	Child <sup>2</sup>	Adult <sup>3</sup>	Child <sup>2</sup>	Adult <sup>3</sup>
Short-term*	14 ppm	--	9800 ppm		
Long-term**	0.6 ppm	47 ppm	420 ppm	1.5 ppm	4.9 ppm

<sup>1</sup>Assumes child with pica weighs 10 kg and ingests 5000 milligrams (mg) of soil per day.

<sup>2</sup>Assumes a 13.2 kg child, and a time-weighted-average soil ingestion of 85.2 mg soil per day to account for weekly and seasonal variability when estimating chronic exposures.

<sup>3</sup>Assumes an adult weighs 70 kg and ingests 50 mg of soil per day.

\*ATSDR has established short-term level for inorganic mercury of 0.007 milligram per kilogram per day (mg/kg/day). It is a level of short-term exposure to inorganic mercury below which adverse health effects are unlikely to occur.

\*\*US EPA has established a long-term level for inorganic mercury of 0.0003 mg/kg/day. It is a level of long-term exposure to inorganic mercury below which adverse health effects are unlikely to occur.

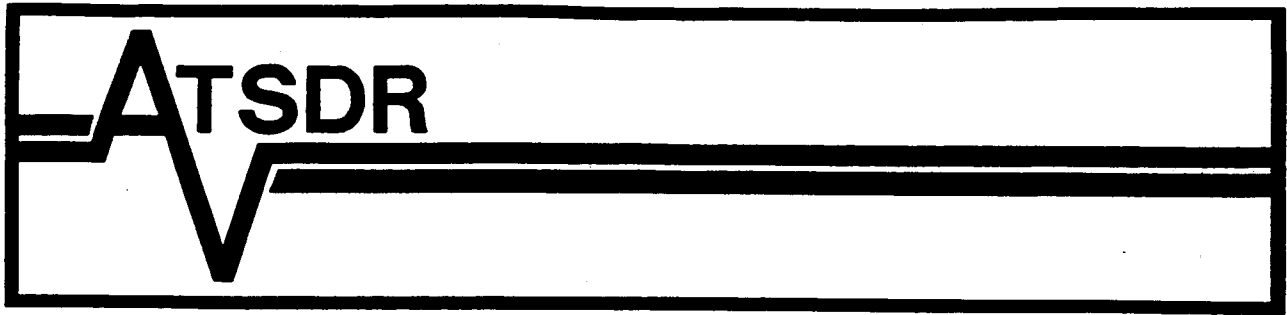
\*\*\*Assumes 40% consumption of homegrown fruits and vegetables.



**APPENDIX C**

**Public Health Hazard Categories**





# **Public Health Assessment Guidance Manual**

**March 1992**



**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Atlanta, Georgia 30333**



Table 8.1. Criteria and Actions for Levels of Public Health Hazard

<p><b>CATEGORY A</b> <b>URGENT PUBLIC HEALTH HAZARD</b></p>	<p><b>CATEGORY B</b> <b>PUBLIC HEALTH HAZARD</b></p>
<p><i>This category is used for sites that pose an urgent public health hazard as the result of short-term exposures to hazardous substances.</i></p>	<p><i>This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances.</i></p>
<p><b>Criteria:</b></p>	<p><b>Criteria:</b></p>
<p>Evidence exists that exposures have occurred, are occurring, or are likely to occur in the future;</p>	<p>Evidence exists that exposures have occurred, are occurring, or are likely to occur in the future;</p>
<p>and</p>	<p>and</p>
<p>the estimated exposures are to a substance or substances at concentrations in the environment that, upon short-term exposures (less than 1 year), can cause adverse health effects to any segment of the receptor population. The adverse health effect can be the result of either carcinogenic or noncarcinogenic toxicity from a chemical exposure. For a noncarcinogenic toxic effect, the exposure exceeds an acute or intermediate minimal risk level (MRL) established in the ATSDR Toxicological Profiles or other comparable value;</p>	<p>the estimated exposures are to a substance or substances at concentrations in the environment that, upon long-term exposures (greater than 1 year), can cause adverse health effects to any segment of the receptor population. The adverse health effect can be the result of either carcinogenic or noncarcinogenic toxicity from a chemical exposure. For a noncarcinogenic toxic effect, the exposure exceeds a chronic MRL established in the ATSDR Toxicological Profiles or other comparable value;</p>
<p>and/or</p>	<p>and/or</p>
<p>community-specific health outcome data indicate that the site has had an adverse impact on human health that requires rapid intervention;</p>	<p>community-specific health outcome data indicate that the site has had an adverse impact on human health that requires intervention.</p>
<p>and/or</p>	
<p>physical hazards at the site pose an imminent risk of physical injury.</p>	
<p><b>ATSDR Actions:</b></p>	<p><b>ATSDR Actions:</b></p>
<p>ATSDR will expeditiously issue a health advisory that includes recommendations to mitigate the health risks posed by the site. The recommendations issued in the health advisory and/or health assessment should be consistent with the degree of hazard and temporal concerns posed by exposures to hazardous substances at the site.</p>	<p>ATSDR will make recommendations in the health assessment to mitigate the health risks posed by the site. The recommendations issued in the health assessment should be consistent with the degree of hazard and temporal concerns posed by exposures to hazardous substances at the site.</p>
<p>Based on the degree of hazard posed by the site and the presence of sufficiently defined current, past, or future completed exposure pathways, the following public health actions can be recommended:</p>	<p>Based on the degree of hazard posed by the site and the presence of sufficiently defined current, past, or future completed exposure pathways, the following public health actions can be recommended:</p>
<ul style="list-style-type: none"> <li>• biologic indicators of exposure study;</li> <li>• biomedical testing;</li> <li>• case study;</li> <li>• disease and symptom prevalence study;</li> </ul>	<ul style="list-style-type: none"> <li>• biologic indicators of exposure study;</li> <li>• biomedical testing;</li> <li>• case study;</li> <li>• disease and symptom prevalence study;</li> <li>• community health investigation;</li> </ul>
<p>(Continued on next page)</p>	<p>(Continued on next page)</p>



**8. Determining Conclusions and Recommendations**

Table 8.1. Continued

<b>CATEGORY A URGENT PUBLIC HEALTH HAZARD (continued)</b>	<b>CATEGORY B PUBLIC HEALTH HAZARD (continued)</b>
<ul style="list-style-type: none"><li>• community health investigation;</li><li>• registries;</li><li>• site-specific surveillance;</li><li>• voluntary residents tracking system;</li><li>• cluster investigation;</li><li>• health statistics review;</li><li>• health professional education;</li><li>• community health education; and/or</li><li>• substance-specific applied research.</li></ul>	<ul style="list-style-type: none"><li>• registries;</li><li>• site-specific surveillance;</li><li>• voluntary residents tracking system;</li><li>• cluster investigation;</li><li>• health statistics review;</li><li>• health professional education;</li><li>• community health education; and/or</li><li>• substance-specific applied research.</li></ul>



## 8. Determining Conclusions and Recommendations

Table 8.1. Continued

<p align="center"><b>CATEGORY C</b> <b>INDETERMINATE PUBLIC HEALTH</b> <b>HAZARD</b></p>	<p align="center"><b>CATEGORY D</b> <b>NO APPARENT PUBLIC HEALTH HAZARD</b></p>
<p><i>This category is used for sites with incomplete information.</i></p>	<p><i>This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.</i></p>
<p><b>Criteria:</b></p>	<p><b>Criteria:</b></p>
<p>The limited available data do not indicate that humans are being or have been exposed to levels of contamination that would be expected to cause adverse health effects. However, data or information are not available for all environmental media to which humans may be exposed;</p>	<p>Exposures do not exceed an ATSDR chronic MRL or other comparable value;</p>
<p align="center"><b>and</b></p>	<p align="center"><b>and</b></p>
<p>there are insufficient or no community-specific health outcome data to indicate that the site has had an adverse impact on human health.</p>	<p>data are available for all environmental media to which humans are being exposed;</p>
<p align="center"><b>and</b></p>	<p align="center"><b>and</b></p>
<p>there are insufficient or no community-specific health outcome data to indicate that the site has had an adverse impact on human health.</p>	<p>there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health.</p>
<p><b>ATSDR Actions:</b></p>	<p><b>ATSDR Actions:</b></p>
<p>ATSDR will make recommendations in the health assessment to identify the data or information needed to adequately assess the public health risks posed by the site.</p>	<p>If appropriate, ATSDR will make recommendations for monitoring or other removal and/or remedial actions needed to ensure that humans are not exposed to significant concentrations of hazardous substances in the future.</p>
<p>Public health actions recommended in this category will depend on the hazard potential of the site, specifically as it relates to the potential for human exposure of public health concern.</p>	<p>The following health actions, which may be recommended in this category, are based on information indicating that no human exposure is occurring or has occurred in the past to hazardous substances at levels of public health concern. The following health actions are recommended for sites in this category:</p>
<p>If the potential for exposure is high, initial health actions aimed at determining the population with the greatest risk of exposure can be recommended. Such health actions include:</p>	<ul style="list-style-type: none"> <li>• community health education;</li> <li>• health professional education;</li> <li>• community health investigation; and</li> <li>• voluntary residents tracking system.</li> </ul>
<ul style="list-style-type: none"> <li>• community health investigation;</li> <li>• health statistics review;</li> <li>• cluster investigation; and</li> <li>• symptom and disease prevalence study.</li> </ul>	<p>However, if data become available suggesting that human exposure to hazardous substances at levels of public health concern is occurring, or has occurred in the past, ATSDR will reevaluate the need for any followup.</p>
<p>If the population of concern can be determined through these or other actions, any of the remaining follow-up health activities listed under categories A and B may be recommended.</p>	
<p>In addition, if data become available suggesting that human exposure to hazardous substances at levels of public health concern is occurring or has occurred in the past, ATSDR will reevaluate the need for any followup.</p>	



**8. Determining Conclusions and Recommendations**

Table 8.1. Continued

**CATEGORY E  
NO PUBLIC HEALTH HAZARD**

*This category is used for sites that do not pose a public health hazard.*

**Criteria:**

There is no evidence of current or past human exposure to contaminated media;

and

future exposures to contaminated media are not likely to occur;

and

there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health.

**ATSDR Actions:**

No public health actions are recommended at this time because no human exposure is occurring, has occurred in the past, or is likely to occur in the future that may be of public health concern.



**APPENDIX D**  
**Response to Public Comment**



**Pyridium Mercury Disposal Site #2  
Response to Public Comment**

This response to public comment was prepared to answer the public's comments on the Pyridium Mercury Disposal Site #2 Health Consultation. The public was invited to comment during the public comment period which ran from June 9, 1995 to July 13, 1995. One reply form was received by the New York State Department of Health. The following is a summary of our response to the comment received. If you have any questions, contact the Health Liaison Program at the toll-free number 1-800-458-1158, extension 402.

Comment

A previous resident of the area was concerned about potential past exposures and possible follow-up testing.

Response

New York State Department of Health medical staff from the Bureau of Environmental and Occupational Epidemiology responded by telephone and a follow-up letter. Responses to medical questions are considered confidential information; therefore, we are not able to provide details of the conversation or follow-up letter.